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November 6, 1924

Engineering News-Record

Recovery of Return and Seepage Water in California

Building a Cliff Road to the Bear Mountain Bridge

Driving a Long Small-Section Wet Rock Tunnel

ALSO:

Engineering News-Record Construction Cost and Volume Index Numbers

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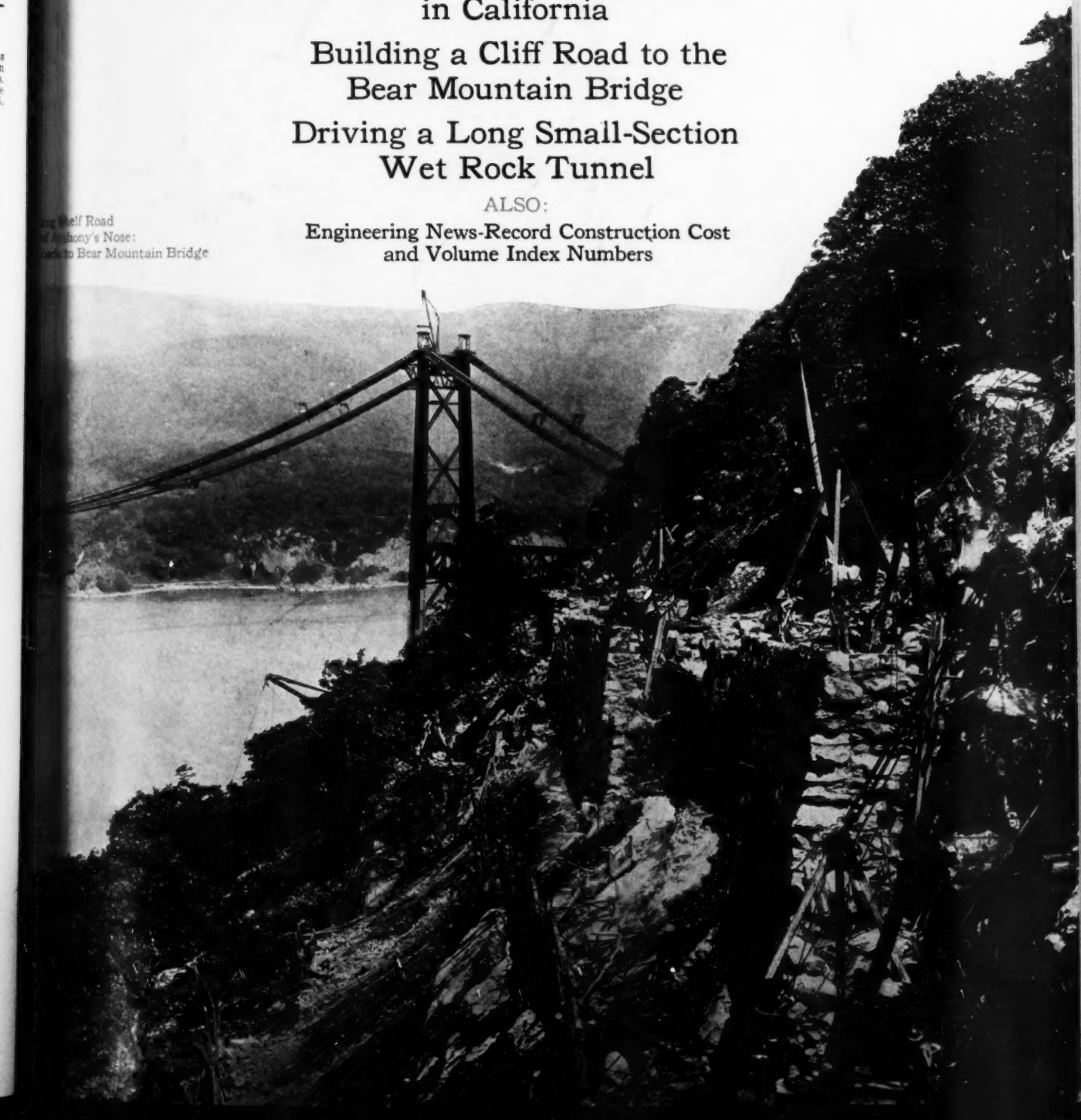
to Bear Mountain Bridge



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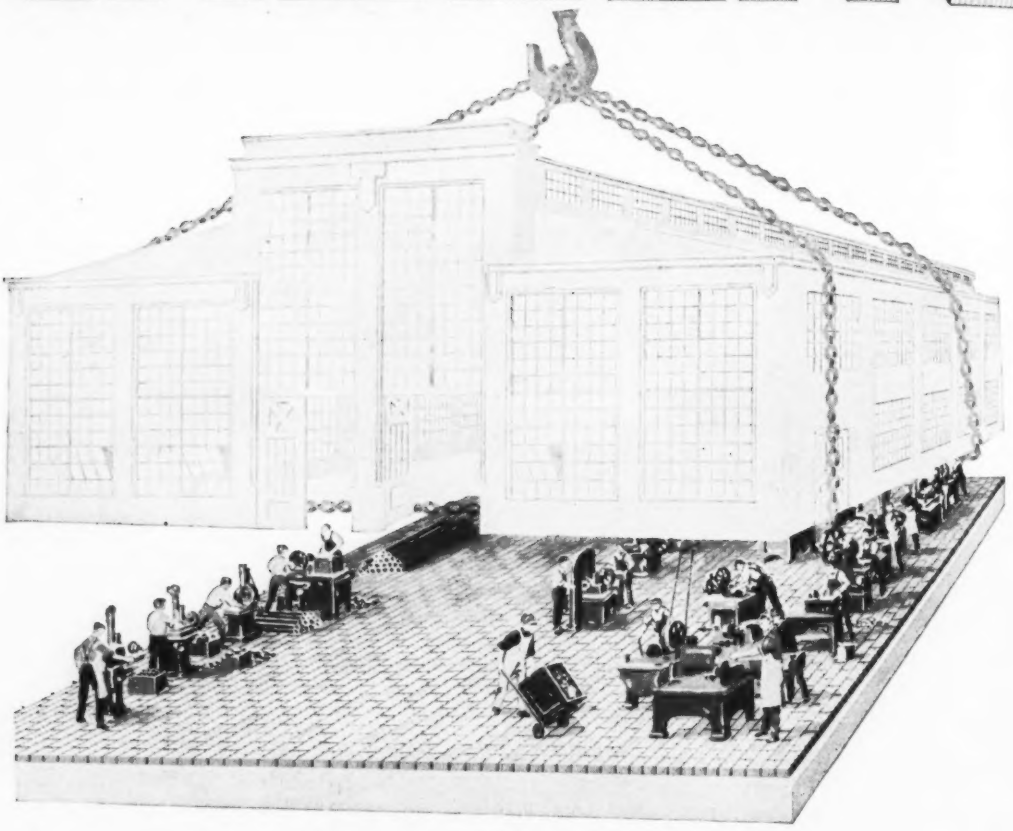

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

FRANK C. WIGHT
Editor

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An Opportunity

CALVIN COOLIDGE is now President in his own right. The people of the United States, like the people of England who voted a week before, are anxious that there be no experimenting in government or social reform just now. But the popular vote, as so far reported, does show—as it showed in England—a large body of opinion on the liberal, or if you please, radical side; so large in fact as to presage a change in party issues. The tariff and the currency are fading in importance; in their stead rises a newer economics, an economics of industry, with the status of labor, taxation and government ownership or control of business as matters in dispute. Mr. Coolidge now has four years to show how sane conservatism can accomplish necessary reform without tearing down the entire economic structure.

Why Not the "Holland Tunnel"?

ENGINEERS rarely have their names carried down to posterity on the work which they build. Eads has a bridge named after him and General Poe a lock, but these are exceptions; the Brooklyn Bridge, the Arrowrock Dam and hundreds of other monumental works remain unrelated by name to the engineering genius that made them. This is proper enough; engineers are modest individuals who do not want to go through life leaving a string of personified structures behind them—and who is to tell just which particular piece of work among the many a great engineer accomplishes shall bear his name. But once in a while an engineer leaves a masterpiece, a life work, leaves it in the height of his powers and a monument to his labor and imagination. So Gaillard left the Culebra Cut; so Holland left the Hudson vehicular tunnel. And as the great earth gash at Panama was rechristened the Gaillard Cut for the army engineer who died almost as a sacrifice to that cut, so it would be a graceful thing if those in charge of the Hudson vehicular tunnel would name that work the Holland Tunnel, in memory of that young but accomplished engineer who more than anyone else was responsible for its design and construction and who, indeed, gave his life to its completion.

Other People's Money

NEWS comes from Idaho that certain interests there are urging the Secretary of the Interior to build the American Falls dam immediately to large capacity, even though present use of the extra storage is not assured. The argument is made that this procedure will reduce the charges upon the lands which will use the stored water. It ignores the unfortunate fact that for quite a few years the superfluous capacity will be simply a luxury, since no users will be on hand to pay the upkeep charges on the added storage cost. Reduction of charges on the benefited lands, in other words, is to be accomplished at Uncle Sam's expense; the economic advantage derived from the increased storage is to go to the initial users of the reservoir free of cost. Such proposals are easy to make when public money is involved, for public funds, which come out of no individual pocket, are just as profitable to the private beneficiary as any other money. The predatory attitude of the Idaho interests is regrettable. Its unscrupulous character is obvious; but perhaps its essential badness can be seen in more glaring light when the results of reclamation project construction during the past two decades are considered. Nearly every project was made the occasion for requests by the interested land holders that the government do more work than was contemplated, and spend more public money. And in nearly every case these requests were acceded to, by Congress and by Secretaries of the Interior. The unremunerative character of the reclamation investment is very largely due to this fact. Irrigation works were built for thousands of acres of lands that have never been put to use even to this day. The public treasury was depleted in order to enrich land speculators and to enable water users to escape part of their obligation. Shall we continue to follow the evil precedent?

Seepage Water as an Asset

AN IMPORTANT corollary of irrigation is the provision for the escape of that amount of water representing the difference between the total put on the land and the amount consumed, i.e., taken up by plants through transpiration and the loss by evaporation. This remainder must go somewhere if the irrigated land is to continue useful for agricultural purposes; too often no such provision is made and having no means of escape the surplus water remains under the irrigated areas, water-logging the land and sometimes bringing up alkali with it as the water table is raised. Under other conditions of soil and topography this water seeps out into natural surface channels or into subterranean storage basins where, by diversion or by the use of wells, respectively, it may constitute a source of supply for reuse on other irrigable lands. Conditions in California that make it possible to use seepage and return water over again, or even twice over, are discussed elsewhere in this issue in an article by T. R. Simpson. In California return water is the source of a number of living streams. The fact that permits to divert such water for reuse are frequently applied for would not in itself be of particular importance but couple with that the fact that in California (and doubtless in other parts of the country as well) the water requirements of the irrigable areas greatly exceed the flow in streams and the importance of reusing the water is apparent. Irrigation engineers will find it profitable to consider this question in the light of experience in the Sacramento and San Joaquin valleys of California.

Tunnel Drainage

ECONOMIC drainage is a major construction problem in long, small-section tunnels in water-bearing rock. An example is presented by the Great Notch tunnel described in this issue. In this tunnel a considerable part of the small section is occupied by pump lines for drainage. These added to the compressed air and ventilating conduits cut down space badly needed for construction operations. Also the pumps located in the tunnel require the transmission of a large amount of power long distances and this is expensive and further encumbers the working space. These facts are not at all novel and they are noteworthy only for suggesting an alternative—the provision in the design of long, small-bore tunnels, of a definite section for drainage. In building some of the great railway tunnels through mountain chains a small service tunnel has been carried along parallel to the main bore. Commonly these service tunnels have had objects beyond their use in construction and always their cost would prevent their use in any but tunnels of exceptional length. There should not be beyond consideration, however, a widening out of the tunnel section to provide space for drainage pump lines, or still better, a drainage ditch. Such a provision is seldom made. Why is it not?

Automobile Killings Increase

ALL that the engineer and health officer have done to reduce the general death rate by cutting down typhoid in the last two decades has been more than offset by automobile slaughterings—and the latter mount higher year by year. The Census Bureau for 1923, from which regrouped selections are given elsewhere in this issue, show increased automobile killings in 1923 compared with 1918 in practically every state and in nearly all cities listed. The instances of decline from 1918 to 1923, even though few, the cases of small increase and the considerable number of cities with low or relatively moderate rates through the whole six years all point to the utter needlessness of the large increases and the high rates in many of the cities. Degree of automobile saturation, efficiency, slackness or lack of traffic control, climate, kind and quality of road surface, number of steam and electric railway crossings at grade and character of population are all factors which in some degree enter into the great variation in the automobile death tolls in the different states and cities. The automobile slaughter has reached such proportions and is increasing so rapidly as to demand immediate compilation and study of all the known or suspected factors entering into its growth and control. The subject deserves all the attention which is about to be given it by the Hoover Highway Traffic Safety Conference which meets in Washington next month.

Mountain Highways

HIGHWAYS skirting precipitous hills and bracketed out from cliffsides typify the adventurous in road building. It is this fact which lends interest to the description in this issue of the highway approach to the new Bear Mountain Bridge across the Hudson River. By the same token the engineering and construction difficulties are certain to be magnified by the public mind. It was so when the railways pushed their tracks across the continent. It was then and it is today the mountain switchback and tunnel and the canyon bridge and not the endless mile on mile for a thousand miles of lightly graded line across the plains of Illinois, and Iowa and Nebraska which the general traveler, and even to a considerable degree the engineer observer, held up to display the difficulties and hardship of engineering construction. We should not quarrel with this fact. All these spectacular accomplishments are hard and call for supreme skill. So was the road construction told of in this issue a hard task requiring skill and again so was the Storm King road built two years ago on the opposite side of the Hudson and so was the Wind River Canyon road in Wyoming and others by the dozen in the mountain states of the Far West. It seems invidious to take an atom even from the distinction of the mountain road builder but in granting him all that is due let us not forget the road builders who are adding mile on mile across the plains. There is not a mile of mountain highways in Illinois but its road builders are threading its flat cornlands each year with a thousand miles of concrete pavement, each mile like every other mile and not a mile demanding more than construction commonplaces. Difficulties of and skill in engineering organization and construction co-ordination which are beyond easy computation, are involved in such an accomplishment.

Why Do Engineers Underestimate?

FOUR years ago an engineering commission made an exhaustive study of the development of the St. Lawrence River for navigation and for power. As part of its investigation it presented an estimate of cost of certain very definite things, which are all described in the report. This estimate placed at around $252,000,000 the cost of the structures necessary for a certain amount of navigation and for a certain development of power. Since then these figures have been used variously. On the one hand, the propagandists for the St. Lawrence scheme have broadcasted them as the final cost of the entire project, while, on the other hand, the opponents have contended that the much advertised cost represented only a part of what the scheme would eventually cost the people of the two countries.

There is a definite moral to this tale. Engineers' estimates and architects' as well are more often under the total cost of the project than they are over it. The $10,000 residence turns out to cost $17,200. The New York State Barge Canal, which was to be built for the $101,000,000 of bonds in 1901, has already cost the State of New York nearly twice that sum. It has become a byword in the public press and in the public mind, this inability of the constructing profession to make a reasonable guess as to the cost of that which it is designing or recommending.

There are two kinds of underestimating. There is, first, an underestimating of the actual total cost for a definite amount of work, and there is the underestimating of the total amount of work which any given project finally involves. The first is not so prevalent as the second, and it has a certain degree of justification. There is always the rising-cost argument. Engineers cannot count on the permanence of unit costs, particularly since the war. It may be, too, that when this underestimating of actual total cost does happen it is due to the optimism of the engineer as to the way his plans are to be carried out. He becomes enthusiastic about a project when it is in its design stage, and he lets that enthusiasm lead him to prospective construction improve-

ments which better judgment should tell him will not be workable and which in the pressure of putting the work through do not eventuate. This is just as true under contract work as it is under force account.

However, this is not the serious kind of underestimating, either in amount or effect. That which is serious is the evident disinclination of the engineer to accept the possibility of ramifications of a project, although he knows very well from history that such ramifications always develop. Why is he afraid to face squarely this possibility? Is it because he is afraid that the total cost, if indicated, will become so high that the project will be killed? Or is he controlled by the difficulty in saying exactly what will become the real and what the doubtful secondary costs that may and always do arise? Rather than to guess at the extent of these secondary costs, does he leave them out altogether or in rare cases put in a contingency addition which he cannot explain or defend, except as an insurance of something which is bound to happen?

This is quite as true of a small work as it is of a large one. The proportion of these additional expenses is generally the same. The only difference lies in the amount. It has become accepted fact that any large project will run far beyond its original estimate. We have notorious examples—the Panama Canal, the New York State Barge Canal, and in more recent times the vehicular tunnels under the Hudson, and the new suspension bridge across the Delaware. In each of these cases, taking hindsight instead of foresight, the engineer can justify the additions which he has had to make. But, and this is the important point, will he or his fellow successor in the future in estimating a similar project or operation take into account these same unknowable contingencies which, though not precisely predictable, are just as bound to arise as are the costs of the actual steel and concrete which go into the fundamental part of the project?

This underestimating may not be serious in any particular case, but it does have an adverse effect in public works in the putting through of necessary projects. Legislators and even voters are coming to regard engineers' estimates with a critical eye. They are in their own minds putting on percentages which they know will be bound to come and to consider the engineer as an impracticable person who can only see the bookkeeping statement of so many cubic yards of concrete and so many tons of steel multiplied by such and such a unit cost, which added together produce a given figure. That this figure always falls beneath the total amount that the people must pay out is very apparent. Years ago, Bernard R. Green built the Library of Congress in Washington inside the appropriation. It used to be said that this is the only piece of government construction of comparable size for which this is true. Exaggeration or not the currency of this impression is sufficient evidence of the state of the legislator's mind.

The budget system of public financing was devised largely to remove the long established struggle between bureau official and legislator as to the real fiscal needs of government branches. The bureau, in the past, purposely overestimated those needs, knowing that the legislature would be bound to cut the estimate. The whole business degenerated into a guessing contest. The careless or ignorant underestimating of the final cost of engineering projects is equally fatal to a fair understanding between executive and legislator, or in private work between planner and financier, for it too sets up always a mental reservation in the financing or appropriating mind as to the reliability of the demand for funds.

Will not engineers add to their standing as practical men if they can achieve a little vision as to the ramifications into which large projects run and admit frankly in starting out that what they are going finally to do is much greater than the cold black and white of present plans?

Bonds or Pay-as-You-Go

PAY-AS-YOU-GO is a sound rule in public as well as private finance, subject to reasonable exceptions. Private debts are as old as man. Public debts are of comparatively recent origin. Their rapid increase of late has caused much concern, some well reasoned and some hysterical. The real danger is that public indebtedness will become, through interest and redemption charges, not merely an unbearable burden in itself but one that will cripple the services it was created to promote and other services as well. In view of these and other considerations, it is a pleasure to note that the leading place on the program of the convention of the National Municipal League, to be opened at Harvard University, Cambridge, Mass., on Nov. 10, has been given to a discussion of Pay-as-You-Go vs. Bonds for Financing Public Improvements.

That taxes as against bond issues is of concern to our readers is shown by the number of articles, pro and con, in our columns. To go back only some ten years: Both *Engineering News* and *Engineering Record*, in their issues of Nov. 26 and 28, 1914, pp. 1090 and 599 respectively, publish notes by E. P. Goodrich, consulting engineer, in which he used the case method to show the superiority of the pay-as-you-go or tax levy plan over bond issues. His position was attacked by Charles B. Buerger in *Engineering News*, Dec. 10, 1914, p. 1180. Less than nine years later, Engineer W. H. Connell, while agreeing that pay-as-you-go saves money for the city or state, maintained that bonds save money for the taxpayer (*Engineering Record*, March 17, 1917, p. 419). A rejoinder in opposition to the Connell and in support of the Goodrich argument, by Adolph J. Post, appeared in *Engineering News-Record*, May 10, 1917, p. 325. Some five years later the same journal (March 30, 1922, p. 513) argued briefly that long-term bonds are an expensive luxury and incidentally favored the pay-as-you-go plan. Only a few weeks passed before the pendulum was swung the other way by Prof. R. M. Haig, of Columbia University, in an article advocating 50-year highway bonds, but on the assumption that roadbeds are permanent and that maintenance will take care of resurfacing (*Engineering News-Record*, May 11, 1922, p. 790, with sympathetic editorial comment on p. 765).

Nearly all the participants in this 10-year discussion have been engineers and all have been close followers of highway engineering and finance or of municipal affairs or both. The question how public works are to be financed concerns thousands of engineers today. In view of this and of the differences of opinion still held after so much discussion, it is desirable that the participants in the coming meeting thoroughly inform themselves as to what has gone before, lest there be merely a threshing of old straw.

Building a Cliff Road to the Bear Mountain Bridge

Shelf Blasted Out of Anthony's Nose and the Manitou Cliffs and Paved with Concrete Gives Access to the East Bridgehead and by the Bridge to the West Side of the Hudson River

By John Mansfield Belknap
Resident Engineer, Bear Mountain Hudson River Bridge and Highways, for the Terry & Tench Co., and the Tench Construction Co., Contractors

CONSTRUCTION operations second in interest only to the construction of the bridge itself were involved in building the east highway approach to the Bear Mountain Bridge described in the issues of *Engineering News-Record*, May 10, 1923, p. 829, and April 3, 1924, p. 568. Starting, at tidewater level, from the Roa Hook Road near the state camp of the New York National Guard about 3½ miles north of Peekskill, the new road continues for 3¼ miles along the rugged slopes of the Manitou Hills and the south face of Anthony's Nose to the east bridgehead and rises at its summit, near Station 127, to an elevation of 410 ft. above the river.

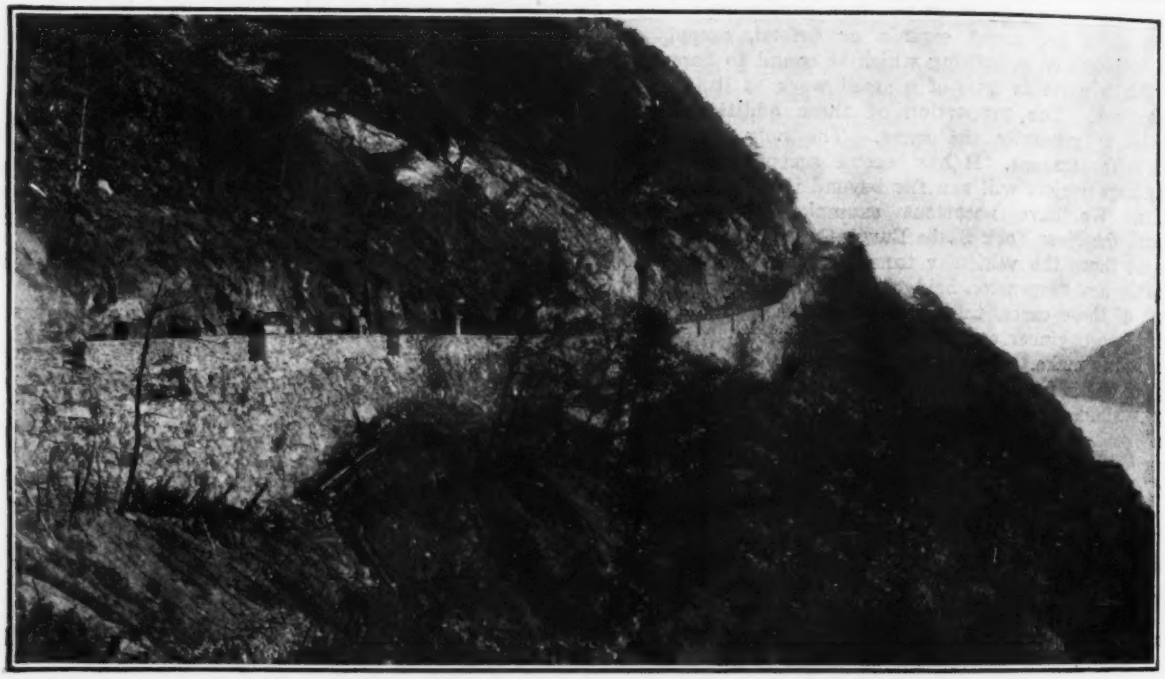


FIG. 1—TYPICAL STRUCTURE OF BEAR MOUNTAIN BRIDGE HIGHWAY
Grading substantially ready for concrete pavement and retaining walls and parapet walls finished. Random rubble masonry harmonizes closely with exposed ledges.

Virtually all of the road structure is sidehill cut and fill. The formation encountered was almost entirely granite lying in ledges and large boulders and over 70 per cent of the material removed had to be drilled and blasted. The road was accessible only at its eastern end, and to add to the difficulties of construction, the tracks of the New York Central R.R. are situated directly below nearly 5,000 ft. of the highway. On this section all methods of construction had, of necessity, to take into consideration the safe and uninterrupted operation of the railroad.

Surveys—A rough preliminary survey of the proposed location was made in September and October, 1922, but it was not until April, 1923, that the actual location was undertaken. At this time a more extended survey was begun and a contour map showing intervals of 2 ft. was developed. The slopes of the Manitou Hills and Anthony's Nose were so heavily wooded and so densely covered with underbrush that it was not possible to make any extended use of stadia measurements in locating the contours and a method of plotting the contours for cross-sections referred to the base line of the survey was adopted.

On the contour map, thus developed, a tentative location was projected and this line was located in the field. The additional information obtained from the field location disclosed several points at which changes were desirable and which would improve the location. In numerous places the slopes were so steep and dangerous that it was necessary to use safety ropes on both men and instruments and at several points the line ran along the edges of the cliffs where a misstep meant a fall of from 100 to 200 ft.

Type of Road—The highway, which has been built in accordance with the standard specifications of the New York State Highway Department, has a reinforced-concrete pavement 6 in. thick at the center and 7 in. at the shoulders and which is 18 ft. wide except on the curves where it is widened and banked in proportion to the radius, the maximum widening being 6 ft. and the greatest super-elevation being at the rate of

1 in. per foot of width. The maximum grade is 7 per cent and the sharpest curves with two exceptions, have radii of 200 ft., the two exceptions being curves of

FIG. 2—RETAINING WALL CONSTRUCTION OUTFIT AT WORK

Cableways supplement the small derricks for handling stone for the walls. Near the right are seen the log, post and wire-rope barriers against rolling stones.

147 ft. radius at Station 74 and at the East Bridge Plaza.

Construction Methods—As the line was accessible only at the east end, construction operations were started at that point and the first steam shovel was cut in at the Roa Hook Road in May, 1923.

In order to complete the grading within the contract time, it was necessary to begin operations on the middle section as early as possible and in June, 1923, a steam shovel mounted on crawler tractors was taken in over an old country road to the north of and about three miles from the located line. For 1½ miles from this point an old military road through the State Reservation was used and from there to the location of the road, the shovel dug its way across the mountain, climbing up to an elevation of nearly 700 ft. and then crawling down to the located line which at this point is 350 ft. above the river.

Compressed air for the drilling operations was supplied from two steam driven compressors of 2,400 cu.ft. capacity each and from a battery of ten portable machines. The drilling was done with Jackhamer and Leyner drills and all of the blacksmith shops were equipped with drill sharpeners.

The greatest part of the excavation was made with the Model 21 Marion steam shovels mounted on crawler tractors, one Erie shovel mounted on traction wheels and one Northwest gasoline crane.

The holes for blasting varied in depth from 4 ft. to 20 ft., the deeper ones being sprung with three or four sticks of 1¼ 8 in. 40 per cent gelatin. Five or six sticks of 60 per cent gelatin, detonated with a No. 6 electric blasting cap, was the customary charge for the average depth holes.

From Station 77 to Station 93 and from Station 127 to Station 164 the line of the road lies directly above the tracks of the New York Central R.R. at elevations varying from 175 ft. to 410 ft., with slopes from the road to the railroad track that in most places are greater than 45 deg. Along these sections the south side of the road is carried on retaining walls built of dry and rubble masonry. These walls vary in height from 10 to 55 ft. above the surface of the ground, with all foundations carried down to solid rock.

Where the rock sloped toward the outside of the wall it was stepped to provide a secure footing. At points where the slope of the rock was steep the steps were cut not less than 2 ft. wide and steel dowels were used to give a firm anchorage.

The excavation for the foundations of these walls developed some very interesting conditions. At numerous points pockets in the rock formation were discovered which made it necessary to carry the excavation 12 and 14 ft. below the surface. At three points along the line of the retaining walls it was necessary to build terrace walls to support loose ledges of rock below the level of the wall foundations before excavation for the walls and road could be commenced. The seams and pockets in these ledges were cleaned of all loose material and then filled with concrete and rubble masonry.

Before any work could be started on the wall sections, protection for the railroad tracks had to be provided and this was done by means of two and in some places three lines of barriers located below the site of the

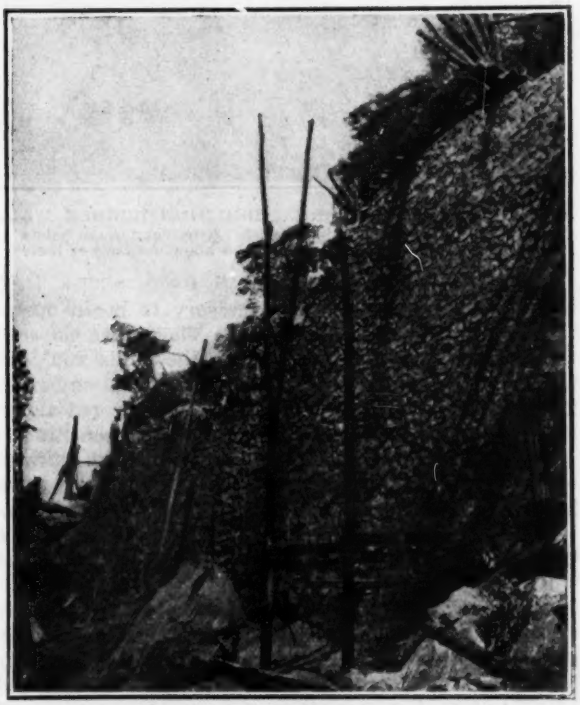


FIG. 3—RUBBLE MASONRY RETAINING WALL OVER FIFTY FEET HIGH

These walls ranging from 10 to 55 ft. high were built of the native granite blasted out of the cut and laid up sometimes dry and sometimes with mortar.

walls. These barriers were built on wood and steel posts tied together with steel cables and reinforced with heavy woven wire fencing and logs. In almost

every instance these barriers served to prevent any of the material blasted from the foundations and roadway from reaching the railroad tracks.

On the section between Station 77 and Station 93 the excavation provided rock of a suitable character for the construction of dry rubble walls and rubble masonry was used only in leveling up the foundations and where the walls were over 20 ft. in height. From the summit of the road at Station 127 to Station 164, the rock from the excavation broke in such shape as to make it unfit for use in dry walls and on this section the walls were built of rubble masonry.

In order to complete this section of the work during

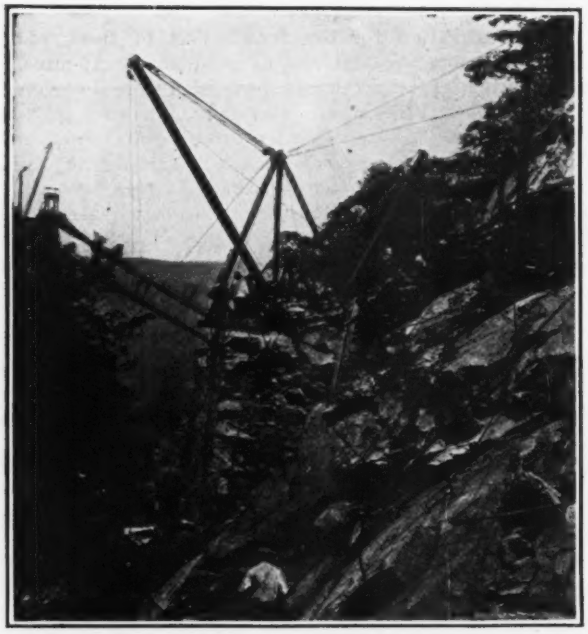


FIG. 4—JINNIWINK DERRICK BUILDING RUBBLE WALL
These derricks were equipped with Little Tugger air hoists for power and could be easily shifted about because of their light weight.

the season of 1924, it was necessary to begin operations at several different points. There was no road over which sand and cement for the walls could be trucked and these materials were transported on barges from a loading dock at Roa Hook and delivered alongside the railroad tracks at two points between Station 140 and Station 160. At these points inclined railways were laid on the slopes and the sand and cement were hauled up the inclines on industrial cars and then distributed along the site of the walls by cableways. The inclined railways and the cableways were operated with air hoists.

The excavated material from the foundations and the rock for the walls was handled by Jinniwink derricks of 1½ tons capacity equipped with Little Tugger air hoists. These derricks were light, could be handled without difficulty over the very rough country and proved to be rapid and economical in operation.

During the entire period of construction there were only two occasions when traffic on the railroad was interrupted or delayed and both of these delays occurred in April, 1924, when it became necessary to remove some ledges of rock, below the site of the road, which had become loose and dangerous from the shock of the blasting above. The removal of these ledges was carried out in conjunction by the engineers and the operating officials of the railroad.

All construction operations on the sections above the railroad were carried on under the supervision of the engineers of the railroad. Telephone connection was established from the site of the work to a conductor's tower near the tunnel at Anthony's Nose and permission to fire blasts was obtained from this tower by railroad inspectors located at various points along the road. No blasting was permitted during the hours of heavy traffic in the morning and afternoon. Both the amount of powder that could be used and the number of holes that could be fired in a shot were regulated by the railroad inspectors and this together with the delays that frequently occurred in obtaining permission to fire blasts seriously delayed the progress of the excavation for the wall foundations and the roadway. By close co-operation between the engineers of the railroad and the contractor's forces the work was brought to a successful conclusion without accidents or damage. The excavated material from the roadway prism was handled in industrial cars, in dump wagons and motor trucks.

Quantities—The main items entering into the construction were as follows: 162,000 cu.yd. of excavation from the road prism, of which about 110,000 cu.yd. were solid rock; 14,550 cu.yd. of excavation from retaining wall foundations; 7,731 cu.yd. dry rubble retaining wall; 17,914 cu.yd. rubble masonry retaining wall, and 372,533 sq.ft. of concrete paving.

From May, 1922 to February, 1923, 54,624 cu.yd. of material were removed which carried the excavation from Station 4 to Station 59 on the east end and from Station 108 to Station 127 on the middle section. The sections of the road from Station 77 to Station 93 and from Station 127 to Station 164 were the most difficult to build and on these sections from March to October, 1924, 65,126 cu.yd. were excavated from the roadway, 14,200 cu.yd. from retaining wall foundations and 6,572 cu.yd. of dry rubble and 17,914 cu.yd. of rubble masonry retaining walls were built. The force employed varied from 250 men in 1923 to 650 men in 1924.

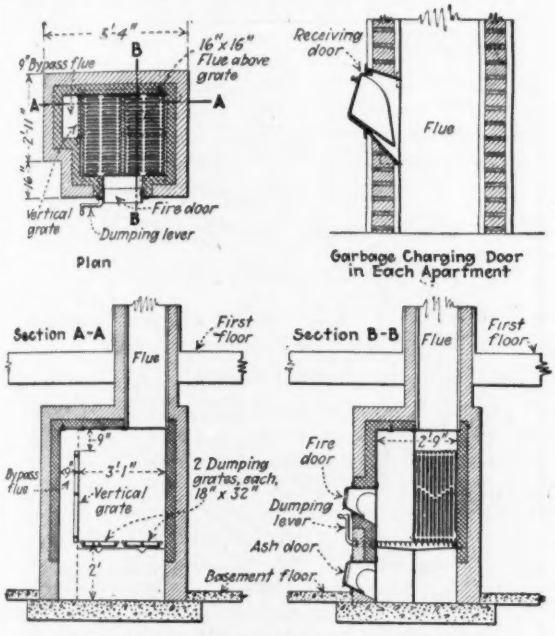
Personnel—The highway was built for the Bear Mountain Hudson River Bridge Co. and will be operated as a toll road in connection with the bridge. Wilson Fitch Smith is chief engineer for the bridge company and Major William A. Welch, chief engineer of the Palisades Interstate Park Commission, was the consulting engineer on the location and construction of the highway. The Terry & Tench Co., Inc., was the contractor for the bridge and road and carried on the work until June, 1924, when it was succeeded by the Tench Construction Co. The location and construction were begun under the direction of H. H. Sherwin, then vice-president and general manager of the Terry & Tench Co., with William H. Heaphy as superintendent. The work was completed and the concrete paving laid under the direction of D. S. McGrath of North Adams, Mass. The writer was resident engineer for the Terry & Tench Co. and the Tench Construction Co. and had charge of the location of the road and all engineering details during construction. H. R. Blackman, C. W. Lovell and A. C. Scott were assistant engineers on location and construction.

Refuse Furnace for Apartments and Public Buildings

Small Incinerator Built into Structure Eliminates Nuisance and Garbage Can—Charging Flue Serves all Floors

GARBAGE and refuse incinerators are now being installed in the basements of a number of apartment buildings and residences and also in certain classes of public buildings, such as schools and hospitals.

The incinerator consists of a firebrick-lined rectangular brick chamber, with a bottom grate and a vertical



GARBAGE INCINERATOR FOR BUILDINGS

grate, as shown. This vertical grate, near the back of the chamber, admits air to the chamber above the fire and thus aids combustion. A brick flue or chimney extends to the roof and has at each floor a charging door through which the material is thrown into the flue and falls into the incinerating chamber. The size of furnace and flue varies with the size of building and number of persons served, but the flue is about 16 in. square for buildings up to six stories and 20 in. for ten-story buildings, or it may be of equivalent circular section. The openings into the flue, about 9x10 in. in the clear, are fitted with hopper doors, opening into the kitchen, so that the openings are practically sealed when the doors are opened.

Garbage, waste paper, rags, crockery, bottles, cans, floor sweepings and general rubbish are dumped into the flue. The accumulation on the grate normally contains sufficient dry combustible matter to make a hot fire which burns up the garbage and subjects noncombustible matter to the temperature of the furnace. Any combustible material not entirely consumed at one burning will be acted upon the next time the furnace is lighted, as the chamber is cleared out only at intervals. As a rule the fire is started once or twice a week. It is lighted at the top and burns downward, the vertical grate and air inlet supplying air in addition to that which enters through the bottom grate.

It is stated that the sooty lining of the chimney prevents the lodging of waste on the walls, while the falling of heavy materials prevents too thick a lining of soot. With the upward draft in the chimney there is no escape of smoke or odor into the rooms, any leakage at the charging doors being into the chimney. The fire is started by the janitor or other attendant, who also removes the ashes and non-combustible materials at intervals. The manager of one large apartment building, housing about 150 persons, reports that the accumulation is burned daily and that occasionally a shovelful of hot coals from the boiler furnace is added, although the combustible matter is usually sufficient to consume the waste. In this case, the engineman in charge of the power plant attends to the incinerator, the ashes and non-combustible matter from which are hauled away with the ashes from the boilers.

A typical example of the application of this incinerator system is found in the partial floor plan of the new Park View Manor apartment building; erected in 1924 at 6834 South Shore Drive, Chicago, of which Alfred S. Alschuler is the architect. This building, with three stories and high basement, has ten sets of apartments on each floor. Each vertical row of apartments has its own disposal service, there being ten incinerators in the basement and ten flues carried up to the roof. In this building the furnaces are about 4x3 ft. in plan, and 6½ ft. high, or 4½ ft above the horizontal grate. The flues are 18 in. square, with tile lining.

This garbage and refuse disposal system, known as the "Kernerator," has been installed in many cities, about 400 buildings in the Chicago district alone being thus equipped. It is being promoted by the Kerner Incinerator Co., Milwaukee, Wis., represented by Hugh W. Ewing, Chicago.

Transport Tax Advocated For London

SIR Lynden Macassey, new president of the Institute of Transport, London, suggests that a transport tax on those commercial concerns using London streets for the transport of their wares is not far off. The efficient provision and maintenance of metropolitan roads and streets depends primarily, he says, on the discovery of new sources of revenue. At present the most fruitful source of new revenue is the large department store whose enormous turnover depends on the existence of means of transport for the conveyance of goods throughout greater London.

The root difficulty in co-ordinating London traffic is multiplicity of ownership. This is aggravated by the fact that municipalities constitute one section of the owners, and they object to any alliance with private ownership. Of the total capital of $569,000,000 invested in local railways, tramways and buses in greater London $412,000,000 is for railways and $157,000,000 for tramways and buses. Of the total, $466,000,00, or 82 per cent, represents private ownership, and $103,000,000, or 18 per cent, municipal ownership—of tramways only. The burden, therefore, of providing London with passenger transportation has been in the main borne by private enterprise with very inadequate return.

Extensive Work in Los Angeles Harbor Recommended

Chief Engineer Approves Plan to Construct Breakwater and Dredge Channel—Port District to Be Set Up

RECOMMENDATIONS for the expenditure of $21,200,000 in improving the harbor at Los Angeles have been transmitted to the House of Representatives by the Secretary of War. The major portion of this amount is to be used in building a breakwater in order to permit the development of port facilities on the outer side of Terminal Island. In 1921 the Chief of Engineers advised against the construction of such a breakwater, but he now states that developments in the past three years have been so great that the conditions upon which the previous report was based have completely changed and that the present situation leads him to believe that with suitable federal encouragement the communities concerned will bend their efforts toward extending the area of the United States tributary to their port, making the latter an important factor in the country's general commerce. The breakwater, he states, "looks not to the present but to the future, in which the port's business would be not only larger than at present but of a quite different character. Los Angeles and Long Beach, in spite of their great tonnage, do not as yet constitute a truly national port. The bulk of the traffic is either oil from the intensively developed adjacent field, or building materials required by the growth of the neighboring communities, which growth is principally due to a heavy influx of population in recent years from all parts of the country. These conditions will not obtain indefinitely. . . . So long as the character of the port remains what it is, there should be no serious difficulty in handling its traffic in the present inner harbor. Local interests, however, now propose to enter the field of general trans-shipment business. . . . Its realization would require that Los Angeles and Long Beach become the gateway of much of the southwestern United States. Given sufficient effort, and proper cooperation among all concerned, this end can be attained. If it is attained, a radical change in the layout of the harbor is necessary. The most compact, economical and satisfactory plan is that providing for development of the outer harbor behind the shelter of a breakwater."

Two locations for the new breakwater are proposed, one following the line of the 48-ft. contour and the other following the line of the 42-ft. contour as shown on the accompanying drawing. The Chief of Engineers approved the construction of the outer one provided the local interest assume the increased cost.

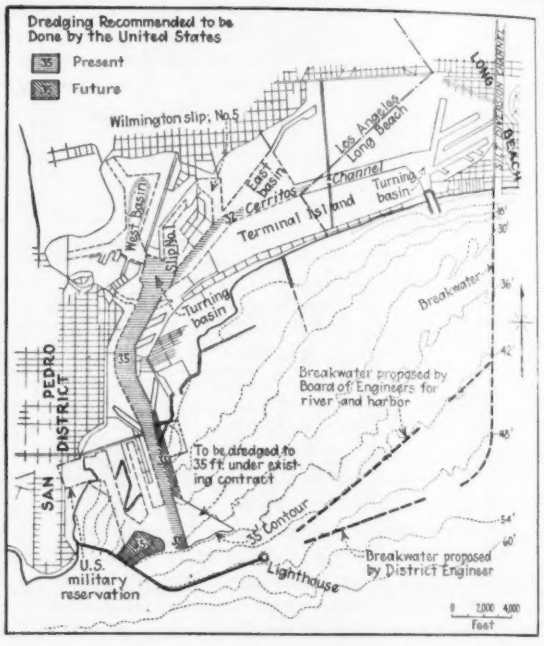
The recommendations of the Board of Engineers for Rivers and Harbors are as follows:

That the existing project for the improvement of Los Angeles Harbor be modified to provide for the dredging to a depth of 35 ft. at mean lower low water of the main channel, from that depth at the entrance up to and including the turning basin; for widening the entrance of this channel to 1,000 ft. with a depth of 35 ft.; for dredging to 35 ft. an irregular area of about 60 acres in the southwest corner of the outer harbor; for providing a channel 30 ft. deep and 300 ft. wide, along the easterly, northerly and a portion of the westerly sides of west basin; and for dredging to a depth of 32 ft. a channel 300 ft. wide, from the turning basin to the Los Angeles-Long Beach line in Cerritos Channel; all on the general lines proposed by the district engineer; and for the construction of a rubble-mound breakwater of dimensions recommended above, extending from the eastern end of the present breakwater generally northeast, turning north and continuing to the mainland just west of the mouth of the silt diversion channel, along the general lines shown on the map, with two openings each 2,500 ft. wide, this width to be modified if deemed necessary, at a total estimated cost of $17,000,000, with nominal maintenance, provided that local interest shall take the following action as items of co-operation:

(a) Cede to the United States, in lieu of that portion of the military reservation at Reservation Point which will be required for widening the main entrance channel, an equivalent area to the east, adjoining the present federal holdings.

(b) Dredge, at their own expense, a portion 200 ft. in width of the proposed 30-ft. channel along the easterly, northerly, and part of the westerly sides of the west basin.

(c) Obtain title to the water front on both sides of Cerritos Channel, for a length of 1,500 ft. at such location as may be approved by the Secretary of War, and reserve



PROPOSED IMPROVEMENTS IN LOS ANGELES HARBOR

it from development, to the end that this section of the channel may be filled and used as an approach to Terminal Island; agree to make or meet the cost of such fill when called on to do so by the Secretary of War, and hold and save the United States from loss arising out of any claims for damage which may be filed as a result of the closure of said channel.

(d) Contribute one-half the first cost of the breakwater, which first cost is now estimated at $14,000,000, funds being made available annually in amounts equal to federal appropriations, for the breakwater.

(e) Organize a port district or equivalent organization, embracing the cities of Los Angeles and Long Beach and such other communities as may be found desirable, with full jurisdiction over the development and operation of the ports and port facilities within these communities; which organization shall prepare final plans, subject to the approval of the Chief of Engineers, and the Secretary of War, for the ultimate development of the port, and shall put them into effect as the need arises.

(f) Create a publicly owned or controlled belt line railroad, or the equivalent, serving uniformly and without discrimination all railroads entering the port and all terminals of the port; the plan adopted to be subject to the approval of the Secretary of War.

(g) Make provisions satisfactory to the Chief of Engineers and the Secretary of War, before any federal funds are expended on the breakwater, for terminal construction in the outer harbor east of the main entrance channel,

having a trans-shipment capacity of at least 1,000,000 tons per year of general cargo. The dredging in the southwest corner of the harbor should be undertaken by the government only when the city's plans for terminals at that point shall have been developed to a point satisfactory to the Secretary of War. The total cost to the government of the work recommended is estimated at $10,000,000. The initial appropriation should be $2,000,000 of which $1,000,000 would be for beginning breakwater construction.

The Chief of Engineers approves of the recommendations of the Board of Engineers for Rivers and Harbors and adds: "Moreover, full compliance with the requirements (e), (f) and (g) should be a condition precedent to the undertaking of any breakwater construction by the federal government. The total estimated cost of the project is $17,000,000, of which the United States will be required to furnish $10,000,000 with nominal maintenance. The initial appropriation should be $2,000,000. It is further recommended that if local interests give satisfactory assurance that they will assume the increased cost, estimated at $4,200,000, the breakwater be built on the site recommended by the district engineer, rather than on that proposed by the board."

Large Concrete Dam to Be Built at American Falls

Designs Now Out for Bids Call for Gravity Overfall Dam in Gorge With Non-Automatic Radial Crest Gates

DEPARTING from the policy which it has followed for a number of years, to build its larger works by its own forces, the U. S. Bureau of Reclamation has just taken bids from contractors for the construction of a new impounding dam on the Snake River at American Falls, Idaho. By providing additional storage and giving better opportunity for adapting the regulated flow of the river to irrigation requirements, as well as by impounding return flow, the new dam will form a valuable supplement to the existing Snake River storage at Jackson Lake, a considerable distance upstream, and will thereby largely increase the water available for irrigation of the Minidoka project, the two Twin Falls irrigation districts, and other irrigation regions lying to the west along the Snake River. It will also furnish water sufficient to irrigate a considerable area of excellent land as yet undeveloped near the Minidoka project, and will enable sufficient power to be developed to pump this water upon the land. The construction of the dam is a co-operative project of the water-using interests affected, working through the Bureau of Reclamation.

The subsoil of the region in which the dam is located is a succession of lava flows with occasional intermediate soils. Basaltic rock is at the surface or under a shallow cover of soil, and sound rock foundation is within reach on the entire crossing, though some of the embankment section will rest on earth. Careful geological examination resulted in approval of the site.

The leading features of the structure as designed are brought out in the accompanying drawing. The dam in the main is a concrete structure, but both end portions are formed by earth embankments. The river gorge itself is crossed by an overfall section, about 650 ft. long, each panel of which is capped by a radial crest gate 33x10 ft., operated through hoisting ropes

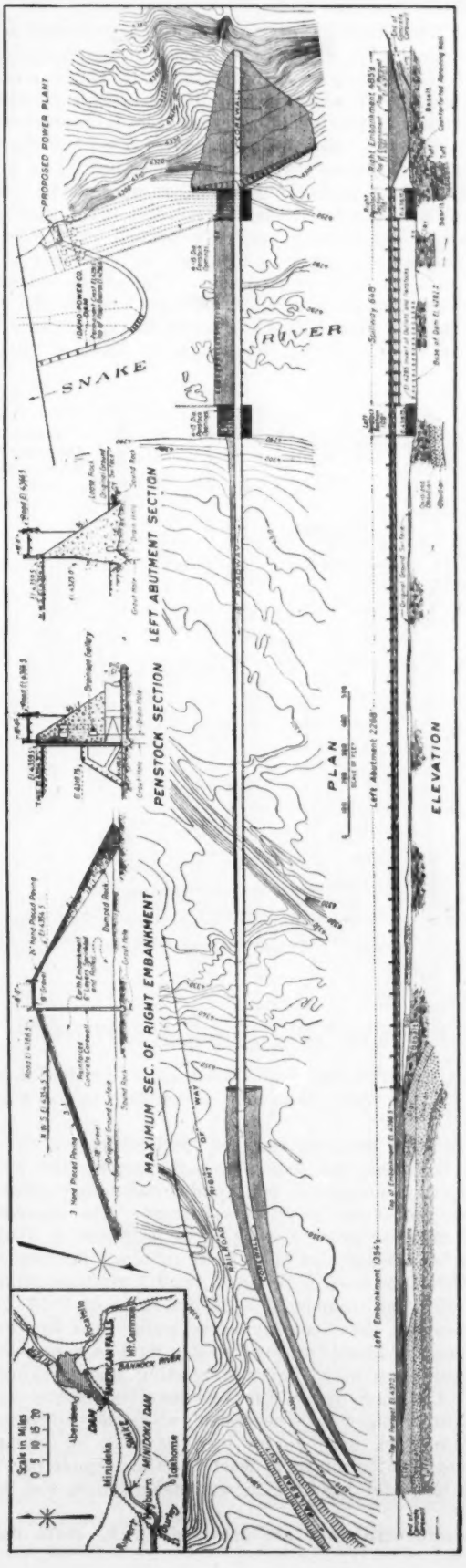


FIG. 1—NEW RECLAMATION DAM AT AMERICAN FALLS, IDAHO
Consisting of concrete main body with short earth-embankment wings—Provision for power generation at both ends of overfall section.

by electric motors set in an operating gallery cored out in the upper part of the dam. A flood flow exceeding 40,000 sec.-ft. requires to be dealt with. Outlet openings through the lower part of the dam are controlled by vertically sliding gates operated from a longitudinal gallery through the dam just above these openings. Penstocks for power development are embedded in the dam at each end, their upstream opening being surrounded by large trash rack structures. That part of the dam which crosses low-lying ground on the left bank consists of a concrete structure of triangular section and a terminal embankment. The entire foundation is intended to be grouted, through holes drilled 20 to 30 ft. deep at 5-ft. spacing along the dam, under a pressure of 100 lb. per square inch. Back of these

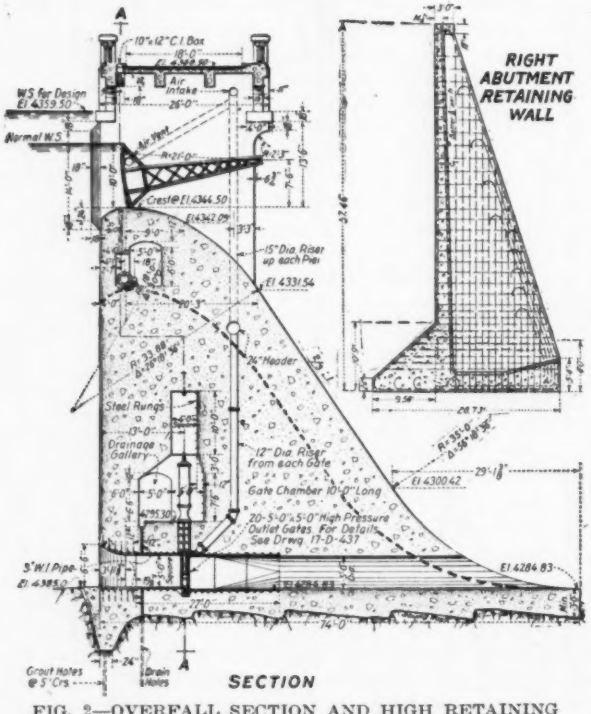


FIG. 2—OVERFALL SECTION AND HIGH RETAINING WALL AT RIGHT ABUTMENT

holes, after grouting, drain holes are to be drilled to carry off any water that may accumulate in the substrata.

As in other contract work of the Reclamation Service in the past, the cement for the work (and also steel, electric equipment, paint and certain other items) is to be furnished by the government. The concrete of the main or gravity work is to be mixed 1:3:4½, with a further addition of 2½ parts cobbles. Reinforced and other thin work is to be of 1:2½:5 mixture, while hand rails and ornamental work are to be of 1:1½:2½. It is specified that "only sufficient water shall be used to secure a workable mix sufficiently fluid to flow properly into place with thorough spading and working" and for the heavy part of the work no softer consistency than 3-in. slump will be permitted, while the reinforced and thin work may go up to 6 or 8 in. of slump. Concrete is to be mixed at least 1½ min. Ample provision is made for bonding, for expansion joints, and the like.

Concrete core walls are provided in the earth embankments, while the embankments themselves are to be sprinkled and rolled in 6-in. layers. A high retaining wall is required at the junction of the concrete dam with the right embankment. The design of this wall, which is of the counterforted type, is shown in one of the sketches.

As the total extent of contributions to be furnished by the water users is still somewhat indefinite, designs for two dams have been prepared, one 13 ft. higher than the other, to give 1,040,000 and 1,700,000 acre-ft. storage respectively. The crest gates and other equipment of the dams are identical. The overfall section shown in the adjoining drawing is that of the higher dam, but the outline of the lower dam is indicated by a dash line. On Oct. 20 bids were received on both structures. The possibility of building the low dam to such outline as to permit of subsequent increase of height has also been discussed. The cost of the low dam will be about $1,500,000, and that of the high dam about $2,000,000.

Dock Extensions Planned at Southampton

SOUTHAMPTON, Britain's greatest port on the south coast and harbor for transatlantic liners, is to be enlarged at an estimated cost of $58,500,000. Such an extension is the result of complaints that Southampton is lacking in some of the facilities necessary for docking the liners of the White Star and Cunard companies, and the Southern Ry., owner of the docks, has authorized almost immediate construction of new approach channels and deep-water jetties, which will not only provide better accommodation for ocean liners but, it is hoped, will attract freight services to the port.

In general, the scheme involves the reclamation of 460 acres of mud flats to form a bay about 2 miles long and ½ mile wide. An enclosing bank will be formed parallel to the channel of the River Test, filling in with material obtained by dredging the approaches to the docks and the existing dock area. The dredged material will be pumped into position.

On the new front thus created five reinforced-concrete jetties will be built, 1,000 ft. long and 260 ft. wide, with a depth alongside of 45 ft. at the lowest water. Each jetty will be equipped with two-story sheds and complete mechanical handling devices for the rapid handling of baggage and cargo. The approach channel to this front will be 600 ft. wide, and designed so that the largest ships can make a direct approach from Southampton Water.

At the same time the railway facilities of the port will be considerably enlarged to handle the extra traffic from the port. The original scheme provided for the construction of two large graving docks, but as a 60,000-ton floating dock has been put into service, the construction of the graving docks has been postponed.

Engineers of the Southern Ry. are now touring Europe to study the latest developments and equipment at Continental ports with the view of incorporating the most modern features in the passenger and freight handling facilities at the new port.

Part of the reclaimed area will be utilized for industrial plants and other requirements in connection with the port. The reclamation of land and construction of the two jetties which will be put in hand first are estimated to occupy five years.

Reinforcing and Subgrade Factors In Road Cracking

By J. T. Pauls
Associate Highways Engineer, United States Bureau of Public Roads, Washington, D. C.

Extract from paper in "Public Roads" for October, 1924

OBSERVATIONS of the Columbia Pike, an experimental road constructed by the United States Bureau of Public Roads near Arlington, Va., after two-and-a-half years' service under traffic, have made possible a number of conclusions with regard to the relation between the cracking of concrete roads and the character of the subgrade and steel reinforcing. The observations also reveal a number of interesting facts with reference to the water-holding properties of the soils composing the subgrades and the relation between these properties and resulting changes in volume.

It is found that subgrade materials with a large percentage of clay not only attain a high moisture content during the wet season but retain a high content during the dry season. Materials of this character subjected to the laboratory test for moisture equivalent will be found to have a high moisture equivalent value. Subgrades having a large percentage of sand do not attain high moisture content. It is also found that subgrade materials composed largely of very fine sand have high capillarity, and that under this condition free water will very often be found between the pavement and the subgrade.

Subgrades composed largely of clay swell and contract as moisture is added or taken away. The effect of this in the case of swelling is to lift the pavement at the edges and on contraction to take away the support at the edges. The result is that the slab, acting in one case as a simple beam and in the other as a cantilever, is broken at the center by traffic. The conclusion is drawn from the observations that subgrades that show as much as 10 per cent volume change, by laboratory test on an entire sample including coarse material, should be covered with a layer of coarse granular material, and a pavement laid on a subgrade of this character should have a longitudinal joint at the center. Longitudinal cracks in a pavement indicate an unstable subgrade either as to supporting value or movement caused by moisture changes. Adding a granular material to such a subgrade increases its supporting value and modifies the effect of any volume change. Pavements on this type of subgrade should be designed with a center joint.

The observations made indicate that plain concrete slabs will crack transversely because of temperature and moisture changes at intervals of from 40 to 60 ft. Smooth subgrade surfaces increase the distance between cracks but the thickness of the concrete does not affect the spacing of the contraction cracks.

Judging by the experience with the experimental sections, pavements reinforced longitudinally will develop transverse contraction cracks, the number, spacing, and size of which will be controlled by a number of factors. If the steel reinforcing is not continuous but is separated by joints, it is expected that no cracks will form less than 30 ft. from any joint, and by a suitable relation of the percentage of steel to the length over which the steel is made continuous the distance may be increased to 60 ft. The position of the cracks will be influenced by the strength of the concrete and the roughness of the subgrade as well as by the percentage and continuous length of the steel. If the spacing of the joints is less than twice the distance in which a crack would form, contraction cracking may be entirely prevented. If the distance between joints is extended, a crack may be anticipated at a distance of 30 to 60 ft. from each joint and the area between these cracks may be expected to crack at relatively short intervals. With a high percentage of continuous steel relatively fine, closely spaced cracks may be looked for; with a low percentage breaks in the steel may be expected to permit wider cracks to form at considerable intervals. Mesh reinforcing in amounts as used in these tests is likely to break at intervals and permit open cracks to form.

Attention should be called to the possible danger of the use of too high a percentage of longitudinal steel, for under such condition numerous fine transverse cracks will develop and there is the possibility that the narrow transverse beams thus formed will crack under traffic.

From the results obtained on sections reinforced longitudinally it would appear that the practice of omitting contraction joints in pavements of this type is questionable. It would appear that where longitudinal steel is used the design should provide for contraction joints from 50 to 100 ft. apart with the steel designed to prevent intermediate contraction cracks from forming. Another method that would probably be more satisfactory, but which might be subject to other objections, would be to make the concrete continuous and to break the steel ½ in. or 1 in. at intervals where it is desired that contraction cracks shall form.

The Automobile Death Toll in the U. S. Registration Area

WITH but one exception, the automobile death toll was higher for 1923 than for 1918 in the 30 states of the registration area which were within the mortality registration area in both years. Cities make a better showing, 8 of 51 showing a decline and one other a downward trend, although the end figures for the six years are the same.

AUTOMOBILE FATALITIES IN THE REGISTRATION AREA OF THE UNITED STATES, 1918 TO 1923

Selected and rearranged from a compilation by the U. S. Census Bureau. In the original table, the returns for 38 states and for 68 cities are arranged alphabetically in two separate lists.

	1923	1922	1921	1920	1919	1918
Registration area[1]						
Total	14,412	11,666	10,168	9,103	7,968	7,525
Rate per 100,000	14.9	12.5	11.5	10.4	9.4	9.3
Registration cities (68)	5,618	4,891	4,415	4,416	3,807	3,609
Total	[3]	17.2	15.8	15.0	14.1	13.7
States with Rates of 20 per 100,000 or More in 1923 (3)						
California	32.6	26.0	24.4	21.1	19.2	16.7
Wyoming	24.1	13.5	[2]	[2]	[2]	[2]
Delaware	23.9	10.5	7.5	9.8	10.4	[2]
States with Rates of 10 per 100,000 or Less in 1923 (10)						
Iowa	9.8	[2]	[2]	[2]	[2]	[2]
North Carolina	9.6	6.4	5.3	5.2	4.1	3.2
Nebraska	9.2	9.9	7.9	8.0	[2]	[2]
Georgia	8.6	7.2	[2]	[2]	[2]	[2]
Louisiana	8.5	15.7	5.3	5.0	3.2	4.4
Montana	8.0	8.1	8.3	8.1	8.1	12.3
Tennessee	7.1	5.7	5.7	5.5	4.3	3.5
South Carolina	6.8	4.4	4.3	5.4	4.4	3.7
Kentucky	6.7	5.2	4.3	3.5	2.9	3.8
Mississippi	4.4	3.4	2.6	2.2	2.3	[2]
Cities with Rates of 25 per 100,000 or More in 1923 (11)						
Camden	35.4	27.9	22.6	17.9	22.6	21.2
Scranton	29.2	20.7	18.0	15.2	14.6	11.7
Trenton	28.3	21.6	21.2	14.1	12.7	13.8
Paterson	27.9	24.5	23.3	13.2	12.9	14.9
Memphis	27.0	25.0	15.1	26.3	17.4	12.9
Hartford	26.3	22.5	22.5	25.7	27.9	21.2
Louisville	25.6	16.4	14.8	11.9	8.1	12.0
Buffalo	25.5	20.1	15.6	20.4	13.5	18.2
Cambridge	25.1	14.4	17.2	20.0	19.2	12.9
Cincinnati	25.1	18.8	19.6	14.2	16.7	14.8
Birmingham	25.0	16.2	22.6	12.7	11.8	15.3
Ten Cities with Rates from 23.5 to 12.0 per 100,000 in 1923						
Pittsburgh	23.5	20.2	17.8	16.6	16.1	18.1
Providence	21.5	21.2	16.3	14.7	19.4	17.0
Chicago	20.4	22.0	20.5	17.3	12.3	11.7
Washington	18.1	14.6	12.1	11.3	13.4	13.1
Boston	17.3	16.9	13.6	11.8	16.8	14.8
New York[3]	16.3	15.3	15.4	13.6	14.0	12.7
Philadelphia	15.3	14.1	10.2	12.3	10.6	12.8
Milwaukee	12.9	13.6	11.1	12.8	13.2	10.8
Jersey City	12.0	11.8	11.9	14.3	13.5	10.2
Cities with Rates of 10 or less in 1923 (3)						
Norfolk	8.2	8.8	18.1	17.0	21.1	12.7
Ft. Worth	6.3	13.2	[2]	[2]	[2]	[2]
New Bedford	6.2	16.5	7.2	9.0	12.5	13.6
States (1) and Cities (8) Showing Declines in Rate or (1) No Change Between 1919 and 1923						
Montana	8.0	8.1	8.3	8.1	8.1	12.3
Lowell	15.6	5.2	18.5	7.1	18.7	19.7
New Bedford	6.2	16.5	7.2	9.0	12.5	13.6
New Haven	16.2	19.4	12.6	17.7	14.9	17.7
Norfolk	8.2	8.8	18.1	17.0	21.1	12.7
Salt Lake City	15.8	19.4	14.8	19.3	11.1	16.8
Springfield	15.9	12.1	16.9	12.9	17.3	18.6
Worcester[4]	17.2	13.8	20.1	13.2	14.0	17.2
Youngstown	24.6	20.4	25.7	26.7	27.7	31.9

[1] 38 states, the District of Columbia and a few cities not in the registration area.
[2] Not in registration area for these years.
[3] By boroughs the rates (for 1923 only) were: Manhattan, 20.9; Bronx, 15.3 Brookly, 12.9; Richmond, 12.5; Queens, 12.3.
[4] 1923 same as 1918 but a general decline for the period.

Driving a Long Small-Section Wet Rock Tunnel

Use of Mucking Machine Enabled Two Eight-Hour Drilling Shifts to be Worked Each Day—Diesel Engine Power for Tunneling Operations a Novel Feature

WITH a construction plant notable in a variety of respects, good progress is being made in driving the Great Notch Tunnel in New Jersey. This progress, too, is against difficulties. Water is complicating the normal troubles of driving a long, small-section rock bore to a degree where the problem of construction drainage, particularly when lining is begun, is raised to capital importance.

Conditions of access and the location of the tunnel are indicated by the map, Fig. 1. The bore is through Watchung Mountain, back of Montclair, and is a part of the new aqueduct, from the Wanaque dam (*Engineering*

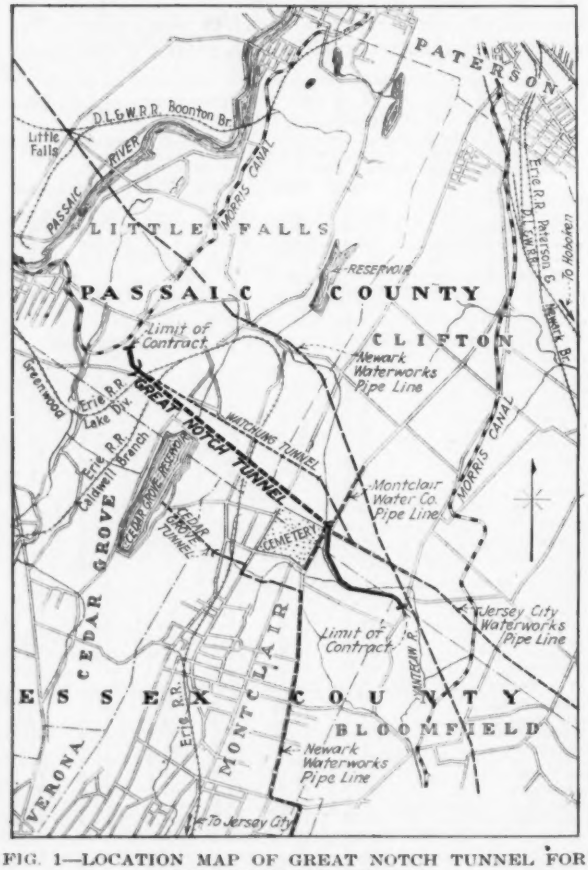


FIG. 1—LOCATION MAP OF GREAT NOTCH TUNNEL FOR NEWARK WATER SUPPLY

News-Record, July 20, 1922, p. 92) for the increased water supply of Newark and neighboring municipalities. Besides the 9,372-ft. tunnel, the construction includes about 4,900 ft. of cut-and-cover aqueduct the construction of which will be described in another article. The tunnel when in service will be under slight pressure but the cut-and-cover conduit is on hydraulic grade. Both are being built by the same contractors under the same engineering direction.

Tunneling Conditions—As will be seen from Fig. 2, the rock bore is about 9x9 ft. for a horseshoe lining 7x7 ft. inside. Fig. 3 is a profile of the tunnel. It is driven wholly from the portals. The grade, as the pro-

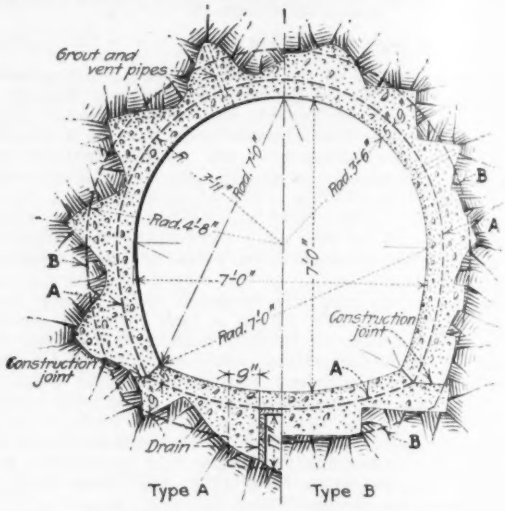


FIG. 2—GREAT NOTCH TUNNEL SECTION

file shows, is very flat—less than 4½ in. in a thousand feet. Gravity drainage thus was not a feasible construction plan even when driving in from the low portal.

From the north end the first 100 ft. are hardpan, requiring timbering, on trap rock. The next 3,150 ft., about, are through trap which is solid and stands without timbering, Fig. 5, but has some fissures which give water. Altogether, however, probably not more than 100 gal. a minute from the trap had to be cared for. Where the trap ends as shown by Fig. 3, there begins a rather shaky sandstone approaching the characteristics of shale. Timbering is required as shown by Fig. 6. Excavated and exposed, this rock goes to pieces quickly. The water condition is bad.

In all, there are about 6,200 ft. of tunnel in sandstone. About 5,200 ft. of the tunnel were driven from the south end and, before work was stopped, as described later, about 910 ft. were driven from the north end after passing the trap. All the sandstone carries a considerable volume of water which trickles and drips in all along and around the bore. The inflow from the 910 ft. driven from the north end is about 300 gal. a minute. From the 3,400 ft. now driven from the south end, the inflow is about 700 gal. a minute and it is fairly uniformly distributed along the bore.

Under these conditions the tunnel construction problem was to provide long air and pump lines and ventilating ducts and do the blasting, mucking and lining in a 9x9-ft. bore, further contracted by timbering for two-thirds of its length.

Tunneling Methods—As first laid down, the plan of construction was to drive from both ends to a junction at about mid-length. The invert was then to be concreted from the portals inward. Then, with forms traveling on the invert, the sides and roof were to be lined. Water conditions modified this plan. With some 3,150 ft. driven through the trap from the north end, the bore, which is down-grade from the north portal, ran into the water-bearing sandstone and drainage be-

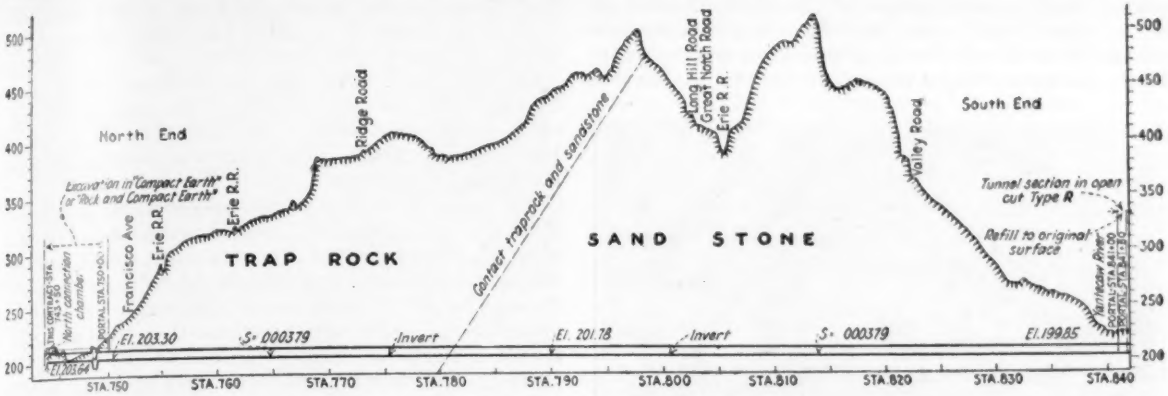


FIG. 3—PROFILE OF GREAT NOTCH TUNNEL

came so great a task that driving was stopped and now waits for the tunnel to be holed through from the south. Meanwhile, the invert is being put in and other steps in the lining process will follow.

Similar methods, modified in the details, were employed for driving the bore in trap and in sandstone. The process is to blast out a full face, load the blasted rock with a power mucker and take away the spoil in cars by storage battery locomotives. In the sandstone, there is the additional operation of timbering. It is less confusing, however, though the general procedure was the same, to consider the work from the north portal in trap separately from that from the south portal in sandstone. Also separate prices for trap rock and sandstone were required in the bid. The volumes were 8,400 cu.yd. and 16,400 cu.yd. respectively.

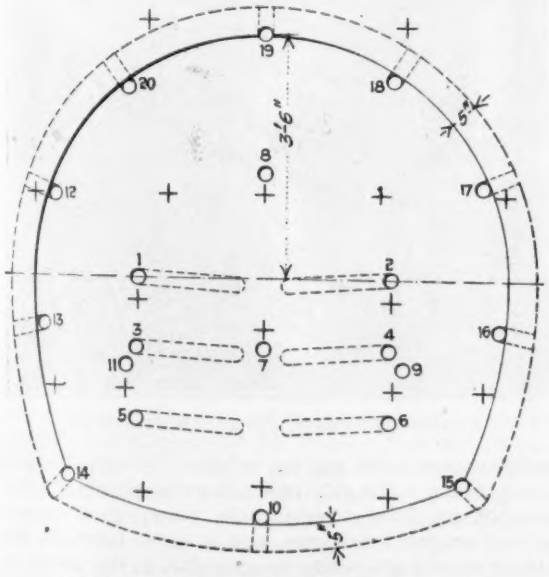


FIG. 4—DRILLING AND BLASTING DIAGRAM

Full face is drilled with 20 holes, as shown above: Cut holes only, Nos. 1 to 7 incl., are then loaded with 8 sticks of powder per hole and fired simultaneously. The first shot does not pull to the bottom, so the same seven holes are loaded a second time with 7 sticks per hole and fired. If the second shot does not pull to the bottom the same seven cut holes are loaded a third time with 3 or 4 sticks per hole and shot again. After the cut is out, the remainder of the holes, Nos. 8 to 20 incl., are loaded as follows: Nos. 8 to 11 incl. (known as relievers) are loaded with 7 sticks per hole and instantaneous exploders. Nos. 12 to 17 incl. (trimmers) are loaded with 6 sticks per hole and first delay exploders. Nos. 18 to 20 incl. (trimmers or breaking down) are loaded with 6 sticks per hole and second delay exploders. All holes, Nos. 8 to 20 incl., are connected to a common firing lead. When circuit is closed the relievers go first, then after about two seconds the side trimmers explode, followed after another two or three seconds by the breaking down holes, which completes the shot.

After the first 100 ft., through earth and rock, to get into the hill at the north end, a full face, Fig. 5, of the trap was drilled, blasted and mucked. Three drills on two vertical columns were used with 1¼-in. round steel and standard rose bits. Changes were made every 2 ft. and normally 8-ft., but sometimes 9-ft., lengths were the last used. The rings in Fig. 4 show the locations of the drill holes. There are 20 holes, which are loaded as, and fired in the order, indicated by the note to Fig. 4. About 8 to 10 lb. per cubic yard of 60 per cent gelatine dynamite were required in the trap to break it small enough for power mucking to the best advantage. An 8-hour drilling shift was allowed. In this time, and ordinarily in less, the crew of six men drilled, loaded and shot a round, making an advance of about 7 ft.

Ordinarily shooting was finished far enough ahead of the time for the mucking shift for the tunnel to be cleared of gases. In any event about 20 minutes were enough to ventilate the heading with some 1,500 cu.ft. of free air per minute from both fans and compressed air jets.

Mucking, as usual, was the controlling operation. Economy required that the contractors should get in two drilling shifts a day. With separate mucking periods then, each shot had to be cleared in four hours. This called for something faster than hand work with the few men who could be worked per shift in the small section.

The adopted alternative was a Hoar mucking machine, Fig. 7, and a 3-cu.yd. side-dump muck car on a 24-in. 20-lb. industrial track. With this equipment the mucking crew consisted of 6 men. As the 3-cu.yd. car was very long, 12 ft., and the mucking machine bucket had a reach of only 5 ft. a short belt conveyor was installed onto which the bucket dumped and which discharged anywhere along the car. From seven to nine carloads cleared away a shot. The locomotive was a 4-ton storage battery machine.

From the south end, when the bore got fully into the sandstone, the general method was the same as that at the north end except that timbering was an additional major operation. The timbering consisted ordinarily of roof segments and lagging. Fig. 6 gives a fairly good notion of the construction which varied somewhat as rock conditions changed. The drill hole arrangement differed as shown by the crosses on Fig. 4, but the shooting sequence was the same. The mucking procedure did not differ greatly, but the mucking machine

did not work so well because of the awkward breakage of the shaly rock. Also the belt conveyor was abandoned. Shovelers in the car trimmed the spoil as loaded by the muckers. There was, of course, the interference

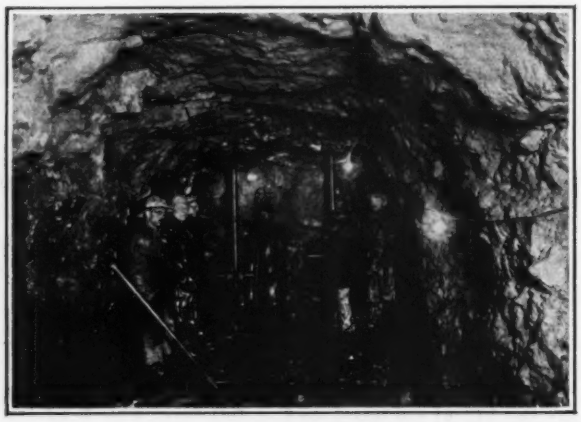


FIG. 5—HEADING IN SOLID TRAP ROCK

of larger volumes of water. From 5 to 6 lb. of explosive, 60 per cent gelatine in 8-in. sticks 1¼ in. in diameter, were used per cubic yard of sandstone rock. Again the high powder factor was caused by the need to break the rock small for the mucking machine.

In general the tunneling methods have worked out well. In particular the power mucker and large muck car outfit have met a difficult situation. Without this equipment it is probable that the average monthly advances of 350 ft. in the north and 320 ft. in the south heading could not have been made. Men are hard to get nowadays who will stick to a hand-mucking job and, if they would, in a small section not enough men can be worked to make fast progress. The unusually large muck car met the conditions of long haul and few trains. Indeed, the whole mechanical outfit has been notable.

Tunneling Plant—Semi-Diesel engine power plants were the unusual item of the tunneling plant. There are duplicate outfits at the two portals. Each consists of a 165-hp. engine. Each engine is belted to (1) an 877-cu.ft. compressor operating drills, mucking machines, pumps and drill sharpener; (2) a 930-cu.ft. blower for ventilating the tunnel; and (3) a 20-kw., 125-volt direct-current two-wire system for tunnel lighting and charging storage battery locomotives. The Diesel engine units were adopted partially as a measure of economy considering steam as the alternative and because at the time of beginning work local electric power stations were crowded and prices for current ran high. With only truck haulage available at both portals the coal supply for a steam plant assumed discouraging proportions compared with supplying oil for Diesel units.

In the tunnel there are a ventilation duct; a compressed air line; a water pressure line for drills; and several pump lines. These are all located low down on one side and snug to the wall, usually set on 1½-in. square pins. Electric wires are carried high up on the side of the tunnel. The water line is 2 in., with 50 lb. pressure. The compressed air, 100-lb. line is 4½-in. well casing. Also 6½-in. well casing is used for the ventilating duct. The well casing has been found highly advantageous. It is light. Two men readily handle a 20-ft. length of the ventilating duct. It is strong, will stand high pressure, is easily and tightly coupled and there is enough joint flexibility to get the line close against the wall. The tight couplings were found particularly effective in cutting down the work of the fans —there was very little air leakage on the long way to the front of either ventilating ducts or compressed air lines.

Drainage Plant and Methods—Drainage is entirely by pumping. At the north end, at first, Cameron pumps operated by compressed air were used; these were of 50-gal. and 200-gal. per minute capacity and pumped through a 4½-in. well casing discharge. As larger quantities of water were encountered in the north end, an electric-driven triplex pump of 175-gal. per minute capacity was installed and later some small 2½-in. centrifugal pumps, electric driven, were put in to handle the additional water encountered through a second line of 6½-in. well casing. These, in addition to a 200-gal. per minute pump, were operated by compressed air. Occasionally small pumps were used to relay to the others which discharged directly to the outside of the portal, this method being used almost entirely while the concrete invert was being placed.

For the south tunnel a 1,000-gal. per minute centrifugal pump was placed in a concrete pit about 8 ft. deep and belt-driven direct from the engine, the suction line being led down through a shaft to the sump at the sides of the tunnel, this sump being 18 ft. under the pump. This layout proved very successful and relayed practically all the south tunnel inflow to the surface, at times

FIG. 6—TIMBERING BORE IN SANDSTONE

pumping over 1,000 gal. per minute. In addition there was another 1,000-gal. per minute centrifugal pump operated by Public Service Co. power as a reserve against engine breakdown and a third 1,000-gal. per minute centrifugal pump was installed at the portal, its motor receiving its power from a generator operated by a fuel oil engine. Thus three pumps, each from an independent source of power, were used to insure against the tunnel being flooded during a power breakdown.

In the south tunnel, 1,200 ft. in, a 900-gal. per minute centrifugal pump was used as a station pump discharging to the portal sump. To this pump were led the discharge from a smaller centrifugal pump and an air pump, both nearer the heading and located near a water inflow point.

The electric power was carried in the north tunnel

FIG. 7—HOAR MUCKING MACHINE AND SPOIL CAR

3,250 ft. by two wires of 0000 alternating current, furnished by the Public Service Co. At the south tunnel direct current from the generators operated by the fuel oil engines was carried in using two 0000 wires. The extension to the small pumps were 0 wires which will be replaced with 0000 wires as more water is encountered.

Personnel—The tunnel is being constructed for the North Jersey District Water Supply Commission with Arthur H. Pratt, chief engineer, Neil C. Haldredge, assistant chief engineer in charge of construction, and Joseph A. Ward, resident engineer. Morris R. Sherrerd is consulting engineer. Heyman & Goodman Co., New York, are the contractors with Robert Parker as general superintendent.

New Track Maintenance System on Paris & Orleans Ry.

Trackwalking and Trackwork Assigned to Separate Forces—All Repair Work Done at Once —American Motor Cars Used

A COMPLETE separation of track maintenance and track inspection forces, and a concentrated system of track maintenance in which all items of work are attended to simultaneously on each successive stretch of about 327 ft. (or 1 hectometer), are unusual features in maintenance-of-way practice on the Paris & Orleans Ry., France. The work involved includes tightening all spikes and joint bolts, adzing rail seats of ties, tamping and shaping the ballast, replacing worn and defective material, adjusting the track to gage, line and surface, and checking the curves to see that they are of uniform radius. On general principles this program is begun at one end of the track section and continued steadily to the other end. But if some point on the section needs attention, the section gang carries out not only the particular repair work required but also carries out the entire program for the corresponding 327-ft. length of track. The period between such maintenance work at any point must not exceed three years on main lines and four years on secondary lines.

On main lines the sections are 3.4 to 3.75 miles in length for double track or 4 to 5 miles for single track, with five men to each section. On secondary lines, all single track, there are sections 4.6 to 5 miles long with four men, and 5 to 5.3 miles long with five men. Previous to the inauguration of the new system, in addition to the regular trackwork, inspecting and maintaining station equipment and signals, cleaning ditches, cutting weeds, repairing crossing gates, etc., these gangs inspected the track and lit the signal lamps beyond station limits. For this latter work, two men quit the gang at such time as to enable them to walk over the track to the opposite ends of the section, tightening any loose spikes or bolts and lighting the lamps. This was the general arrangement for both main and secondary lines before the World War.

An anomalous condition in the maintenance work was that the cost per mile was higher on the secondary lines. According to a paper in the *Revue Generale des Chemins de Fer*, by M. Albagnac, division engineer of the railroad, this condition was due largely to the relatively large gangs required for long sections in order to compensate for the loss of time in walking to and from work. To reduce the expense, the new system introduced on secondary lines includes three changes: (1) tamping by compressed air; (2) use of motor cars to transport men and materials; (3) separation of maintenance work from inspection or trackwalking.

On the secondary lines, therefore, there are now both inspection and maintenance sections. The former are 7½ to 10 miles long, each in charge of a single trackwalker, who lives near a station or local stop so that he can use the regular trains for part of his daily round trip. The maintenance sections are 12½ to 20 miles long, each with six regular men and from one to five day laborers according to the season and the work to be done.

The trackwalker has to clean and lubricate the switches, maintain signals and signal connections, light signal lamps, adze ties, tamp ballast (when the work is not of such importance as to call for the maintenance gang), clean ditches and drains, clear the ballast at joints, and do all such repair work as can be done by one man. He may also be required to paint signals and crossing gates and perform other work as specifically directed. It will be understood that while this inspection and routine or light repair work is in progress a maintenance gang is systematically working its way along the section and putting the track in good condition in all respects, as explained above.

To use the regular trains for transporting the maintenance gangs and their material was expensive and inconvenient, causing much loss of working time. After the war, therefore, the railroad company purchased a number of American motor section cars that had formed part of the equipment of the engineer forces of the American army. These were enlarged so as to carry from ten to twenty men, and the transmission gear was altered to allow the car speed to be regulated independent of engine speed. A windshield is also fitted for the comfort of the operator. These motor cars haul small flat cars for rails, ties and other materials.

New York Increases Reforestation Stocks

The Conservation Commission of the State of New York is preparing for tree planting on a very large scale to assist the reforestation movement in the state. In the commission's nurseries, 2,564 seed beds have been planted this year that will produce 30,000,000 young trees suited for planting two years hence; this compares with 7,000,000 two-year-old trees ready this fall for planting now or in the spring, and 6,000,000 trees three years old ready now. The commission supplies the trees at cost to encourage use of lands now idle.

Skew Bridge for Fly-Over Junction at Chicago : I.C.R.R.

Bridge Replaces Main Track Grade Crossing—Ball Bearings for Girders—Derrick Cars Place Long Heavy Girders

A FLY-OVER junction with long skew spans, built to carry a freight connection clear of the main line, is one of the many works included in the extensive terminal improvements of the Illinois Central R.R. at Chicago. Its construction involved special foundation work and the erection of large girders over busy main-line and suburban tracks, as shown in Fig. 1.

From the Markham terminal freight yard, just south of Chicago, and from two yards within the city limits, freight tracks are laid on the east side of the right-of-way northward to the city freight terminals. But at 41st St. a connection is required with the stockyards line of the Chicago Junction Ry., on the west side of the right-of-way and elevated above the streets, while the Illinois Central R.R. is below the street level. This connection consisted formerly of an inclined track and a series of crossovers through the main tracks, but it was desirable to eliminate such interference with heavy main-line passenger and suburban service.

With the new arrangement, a freight track on the east side rises by a grade of 1.64 per cent on a concrete viaduct parallel with the main tracks, and then crosses these tracks by steel spans connecting with the elevated line of the Chicago Junction Ry. From the concrete viaduct, this fly-over line has a curve of 10 deg. running into a tangent which crosses the main line at an angle of about 45 deg. Provision is made for a future inclined approach from the north, on the west side, so that freight movements between the east and west sides of the right-of-way can be made without interference with the main or passenger tracks. The general arrangement is shown in Fig. 2.

Foundations—Concrete piers 4½ to 7½ ft. in diameter, sunk to bed rock at about 40 ft. below rail level, to carry the steel bents, have the unusual feature of heavy steel reinforcement extending to a considerable depth. This reinforcement was introduced to resist stresses due to traction and centrifugal forces on spans at a long angle with the steel bents which carry them.

Double piers were required at bent No. 3 (see Fig. 2), where a 16-ft. sewer running parallel with the main tracks is only a few feet below rail level. At each end of the bent, therefore, there are two piers 33 ft. c. to c., carrying a heavy steel box girder on which is seated the steel column directly over the sewer. Two piers are required also at bent No. 2, one of these for the steel column and the other carrying a diagonal brace to support the column against lateral forces due to the skew position of the girders which it carries.

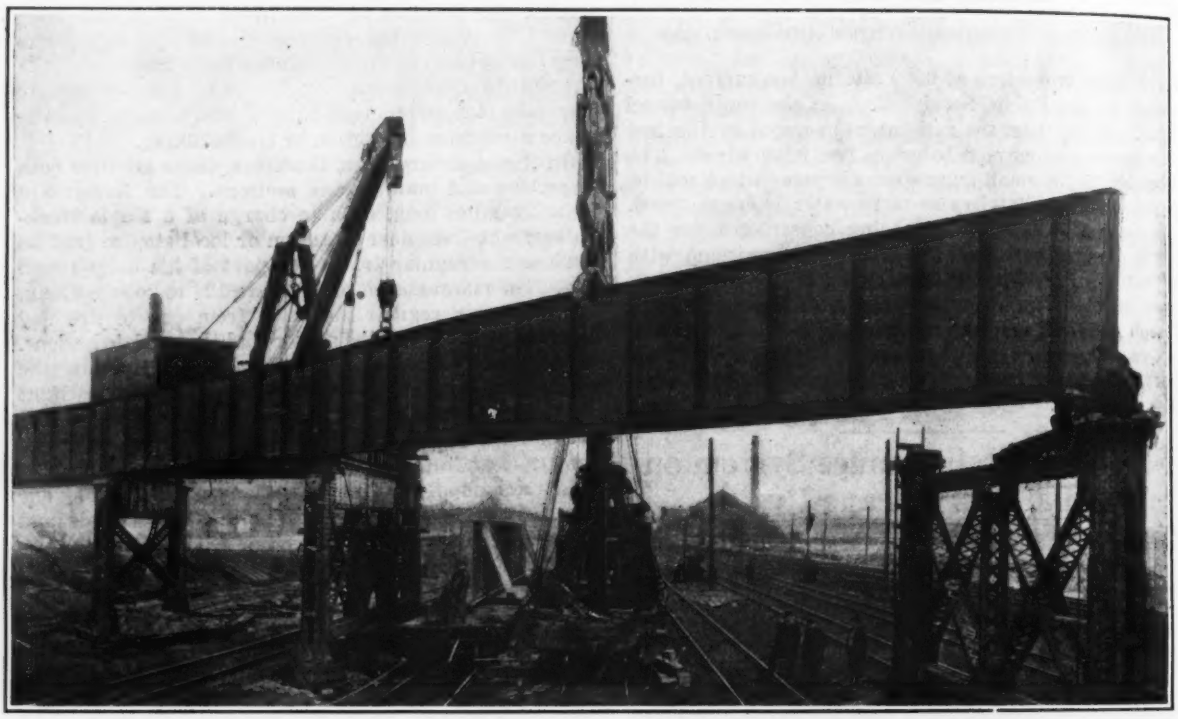


FIG. 1—TWO DERRICK CARS PLACING BRIDGE GIRDER

Steel Structure—Columns of unusual section are employed for the bents, as they have to be narrow to provide clearance between the tracks and have also to be made very rigid laterally on account of the skew position of the spans. Thus in the typical bent No. 7, Fig. 3, each column is 17½x36 in. in section and is composed of three transverse webs, two longitudinal cover plates and twelve lines of flange angles, with batten plates across the angles at the narrower ends.

From the Chicago Junction Ry., there is a 32-ft. span to the Illinois Central R.R. right-of-way, followed by two 70-ft. spans and a complicated tower span of 48 ft. which provides for the future west-side approach. Beyond this tower are three spans of 76, 95 and 103½ ft.,

followed by four deck spans of about 27 ft. A uniform depth of 9½ ft. for all the long spans was adopted for the sake of good appearance, although it involved some excess material.

Ball-and-socket bearings for the girders, instead of the usual shoes, form a special detail, Fig. 3, which was adopted on account of the heavy skew and the consequent tendency to warping or lateral rocking of the girders under load. The bed plates at expansion bearings carry hemispherical studs or balls of 4-in. radius, the ball having a 3½-in. stem fitted to a hole in the bed plate. Corresponding cups or sockets about 2 in. deep are provided on the rocker shoes under the girders.

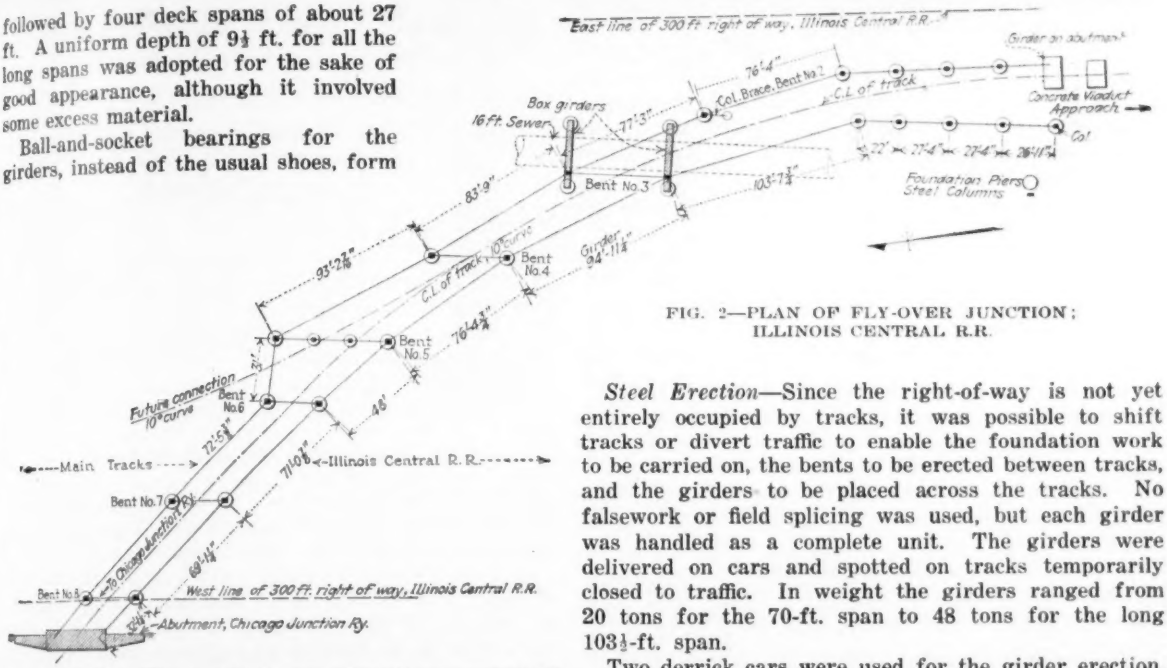


FIG. 2—PLAN OF FLY-OVER JUNCTION; ILLINOIS CENTRAL R.R.

Floor System—The girder spans have 32½-in. plate-girder floorbeams resting on the bottom flanges (Fig. 4) and riveted to large gusset plates. Between these floorbeams are framed seven lines of 15-in. I-beam stringers carrying a 24-in. concrete deck slab with curbs holding stone ballast 6 in. deep under the ties. A 5-ply waterproofing membrane on the slab is protected by a 1½-in. layer of mastic. In the tower span and the corners of adjacent spans, the floor framing consists of transverse 20-in. I-beams spaced 13 in. c. to c. and cased in concrete to form a continuation of the deck slab. This bridge is designed for Cooper's E-60 loading.

Concrete Casing of Steel—All steel will be cased with poured concrete, reinforced by expanded metal tied to the steel members, as shown in Fig. 4. The lower part of each bent will be enclosed in a concrete collision wall 24 in. thick and 6 ft. high. A 1:2:3 mix will be used on the girders, columns, laterals and floorbeams, with 2 in. of 1:2 mortar for the bottom.

Washed gravel with a minimum size of ¾ in. will be used for concrete between the forms and the structural steel where the clear distance is 6 in. or less, and a maximum size of 1½ in. elsewhere. For the collision walls, washed gravel or crushed stone will have a maximum size of 1½ in. The specifications require that "the quantity of water used in mixing shall be the least amount that will produce a plastic or workable mixture which can be worked into the forms and around the reinforcement." A spaded surface finish is specified. Cast-iron blast or smoke plates 4 ft. wide, will be provided over eight of the fourteen tracks.

Steel Erection—Since the right-of-way is not yet entirely occupied by tracks, it was possible to shift tracks or divert traffic to enable the foundation work to be carried on, the bents to be erected between tracks, and the girders to be placed across the tracks. No falsework or field splicing was used, but each girder was handled as a complete unit. The girders were delivered on cars and spotted on tracks temporarily closed to traffic. In weight the girders ranged from 20 tons for the 70-ft. span to 48 tons for the long 103½-ft. span.

Two derrick cars were used for the girder erection, which was started at the west end. On one of the tracks at the lower level was placed a 60-ft. derrick car weighing 80 tons and having a 50-ft. boom; its hoisting capacity was 50 tons with boom lowered to

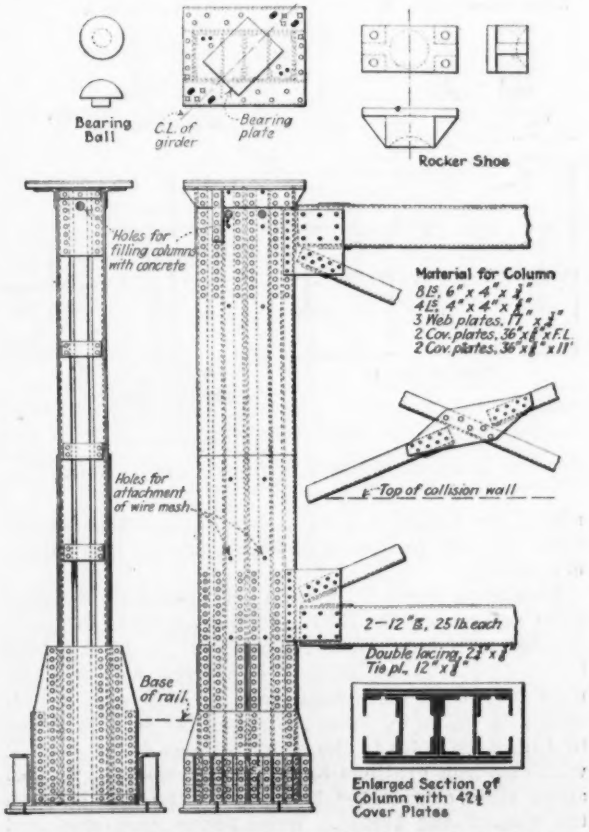

Bearing Ball
C.L. of girder
Bearing plate
Rocker Shoe
Holes for filling columns with concrete
Material for Column
Holes for attachment of wire mesh
Top of collision wall
2—12" I, 25 lb. each
Double lacing, 2½" x ⅜"
Tie pl., 12" x ⅜"
Base of rail
Enlarged Section of Column with 42½" Cover Plates

FIG. 3—HEAVY CONSTRUCTION FOR STEEL BENT
Note ball-and-socket bearing for girders

bring the top-lift falls horizontal. On the erected structure was placed a 40-ft. 45-ton derrick car with 40-ft. boom, having a capacity of 25 tons with top-lift horizontal. The shorter girders were handled by the smaller derrick, but for the long and heavy girders the larger derrick was employed, or in some cases both derricks took hold, as shown in Fig. 1. The lighter derrick then placed the floor system.

In erecting the 48-ton 103½-ft. girders, each girder was handled by two derrick cars of 50-ton capacity, with 50-ft. booms taking hold near the ends; both cars were on the ground level and on parallel tracks. This arrangement was necessary because the girders crossed the tracks at a considerable angle and also because it was not permissible to shift the tracks under this span so that one derrick could be attached to the middle of the girder. These local conditions, with the close clearances and the desire to avoid taking any chances in work on an operated line made it desirable to adopt the arrangement described.

Concrete Viaduct—For the east incline approach there is a single-track concrete viaduct, Fig. 5, built in lengths of 60 to 75 ft. and having spans of 20 to 25 ft. c. to c. of piers, with reinforced-concrete footings on timber piles. Two rectangular columns form each pier and support a deck slab ranging from 24 to 31 in. thick, depending on the length of span, with curbs to

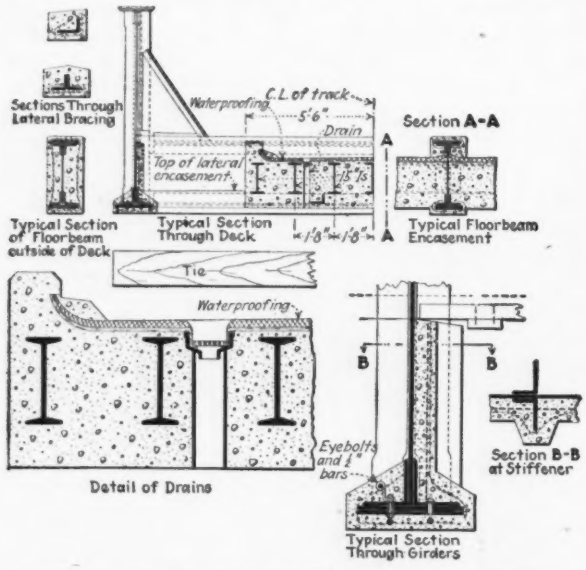


FIG. 4—FLOOR SYSTEM AND CONCRETE CASING

retain the ballast. A 6-in. slab 35 in. wide extends from one curb to form a footwork, and an iron railing is supplied.

Expansion joints 1 in. wide are formed in the twin piers and across the deck. In the columns, the joint is filled with bituminous composition for 11 ft. above the footing. In the deck it is covered with a 12-in. plate of No. 16 galvanized iron, set loosely in a ¼-in. recess 14 in. wide. For drainage, the deck is sloped to 4-in. weep holes in the slab, the holes being covered with cast-iron gratings to retain the ballast. A steel apron plate carries the ballast over the gap between the viaduct and bridge. Wood forms were used and care was taken to have a smooth surface finish. For

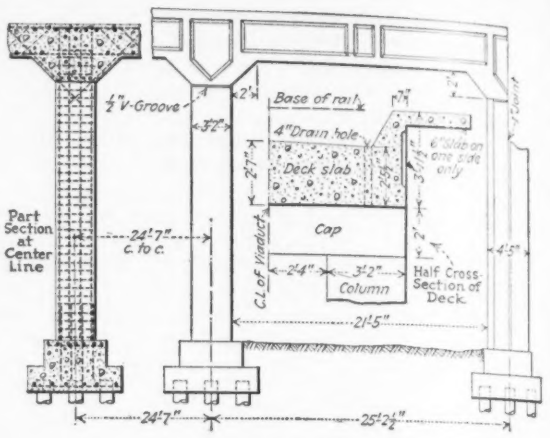


FIG. 5—CONCRETE VIADUCT APPROACH

appearance, recessed panels 1⅛ in. deep are formed in the face of the slab, with a horizontal V-groove on the construction joint at the top of each column.

Engineers and Contractors—The steelwork for this bridge was fabricated by the American Bridge Co. and erected by the Kelly-Atkinson Construction Co., Chicago, with W. J. Howard as superintendent in charge of erection. Foundations and the concrete viaduct were built by the Mid-City Engineering Corporation. The Wieboldt Construction Co. has the contract for the concrete casing of the steel. The structure was designed under the direction of the railroad company's Chicago Terminal Improvement organization, of which D. J. Brumley is chief engineer and C. H. Mottier is engineer of design. Its construction was done under the operating department of the railroad, of which F. L. Thompson is chief engineer, and C. C. Westfall, engineer of bridges; S. B. Christopher was engineer in resident charge of construction.

Tidal Power to Be Developed in France

A DECREE which places the Aber-Vrac'h scheme for the development of tidal power on the basis of a public utility has been published in the *Journal Officiel* in France. Under this decree the Minister of Public Works becomes responsible for part of the capital up to 10,000,000 francs, or about half the estimated cost of the work. The whole scheme consists of three parts, the dam and power plant of the Aber-Vrac'h estuary at Beg-en-Toul, Department of Finistère, a hydro-electric plant at the falls of the Diouris at Kerabo, and a high-tension transmission line from the power stations to Brest.

The hydro-electric plant at the Diouris will be used to supplement the tidal power plant in order to maintain the greatest possible continuous output. The total yearly output is estimated at 11,000,000 kw.-hr.

A French private company with a subsidy from the government will operate the plants in an effort to prove to the satisfaction of governmental authorities that various resources exist in France which may be developed in order to supplement the coal supply which is still deficient as compared with industrial needs. The plan is in conformity with that which is developing the hydro-electric plants of the Alps and Pyrenees for railway and industrial electrification.

Recovery of Return and Seepage Waters in California

Applications for Right to Divert Return Flow Are Frequent—Area Irrigated with Such Water Is Rapidly Increasing

By T. R. Simpson
Assistant Hydraulic Engineer, Division of Water Rights, California Department of Public Works

THE DEVELOPMENT of the water resources in California has reached a stage where the recovery of waste, seepage and return water for use has begun to assume a prominent position in the foreground of irrigation development. The gross amount of water diverted from streams for irrigation purposes, in most cases where the source of supply is adequate, is considerably in excess of the amount consumed by plants through transpiration and by evaporation. That water not accounted for by consumption, that is, evaporation and plant transpiration, finds its way to a drainage channel, underground reservoir or lake, either directly in the form of surface waste, or indirectly by percolating to the water table underlying the area where seepage occurs. Among articles on the distribution of water to underground storage appearing in *Engineering News-Record*, three may be found as follows: Oct. 27, 1921, p. 683; May 11, 1922, p. 770, and June 26, 1924, p. 1088.

Seepage water becomes particularly important where physical conditions permit its recovery for use. It is possible in many cases to recover the same water for use more than once. In these instances the allowance of a discrepancy, between the gross amount diverted and the amount actually consumed, may not be contrary to the public policy of encouraging the best utilization of water, since actual consumption increases but very little with amounts of water greater than 6 or 8 in. in depth per irrigation applied to average irrigable lands. The optimum duty of water usually is obtained by using an amount slightly in excess of that actually consumed, in order to keep water available for plant roots.

Two methods are in common practice for recovering seepage water, namely, by diversion works in artificial and natural drainage channels into which the water finds its way, and by intercepting the seepage through pumping from wells in the lower areas where the seepage accumulates. Pumping from wells as a means for drainage, where the soil is not too fine, appears to be gaining favor over open and underground drains in water-logged areas. However, the salinity content of return water in certain localities renders it unfit for irrigation use, and materially affects its disposal.

But meager data are available as regards the proportion of water, which is diverted to upper lands and used for irrigation, that again becomes available for use. Local conditions of soil, crops, climate, topography and many other factors enter into the return water situation, which make proportions available in one locality seldom applicable to others. Due to the rapid increase in acreage irrigated in recent years, the amount of return and seepage water has been increasing. With the storage projects proposed and in the process of development at present, there will be continued expansion of irrigated areas for many years and consequently the return water situation will become of increasing importance.

Normally all of the waters of Stanislaus, Tuolumne and Merced Rivers, after the middle of July and for the remainder of the irrigating season, are diverted at the edge of the Sierra foothills in the vicinity of Knights Ferry, La Grange and Snelling, respectively. Likewise, the San Joaquin River waters are entirely diverted in the vicinity of Mendota during the latter part of the irrigating season. Consequently, all of the area irrigated from the San Joaquin River between Los Baños and the mouth of the river is dependent wholly upon return water in the latter part of the summer.

Records of flow at the gaging station on the San Joaquin River near Vernalis during the latter part of the summer indicate the net return flow, neglecting diversions, of the above four rivers. During August and September, 1922, the average flows at this point

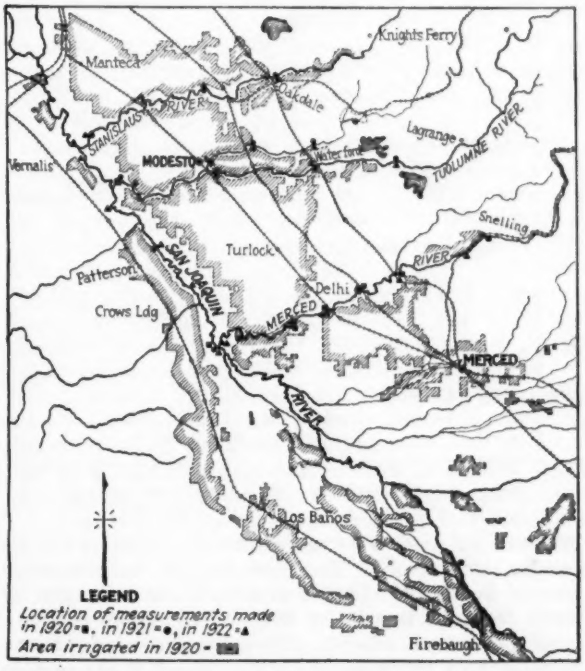


FIG. 1—LOCATION OF RETURN WATER MEASUREMENT STATIONS IN SAN JOAQUIN VALLEY

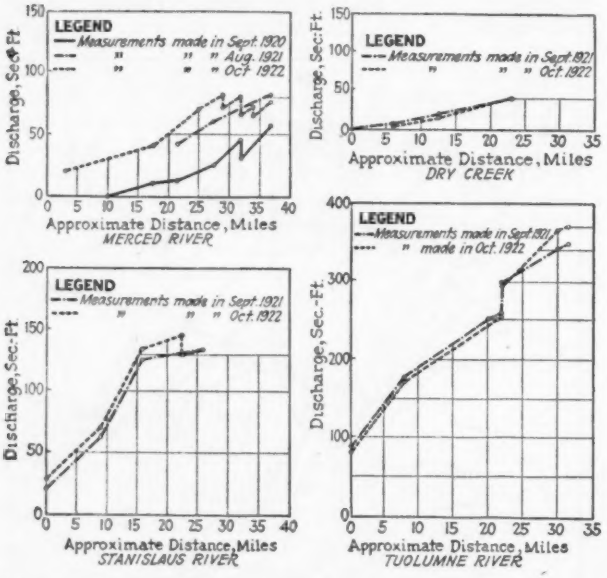
were approximately 1,390 and 784 sec.-ft. respectively. Total diversions of return water above Vernalis from these four rivers approximated 200 sec.-ft. during these two months. Therefore the gross amount of return water from these four streams above Vernalis, for the two months, averaged nearly 1,600 and 1,000 sec.-ft. No records of runoff of the San Joaquin River at Vernalis prior to August, 1922, are available. Complete records of all diversions from the four rivers, for irrigation of the area that contributes the return flow above Vernalis, were kept during 1922. Little information is available concerning the average lapse of time between the application of the water to the irrigated areas and the return by seepage to the river.

In 1922 a shortage of water for diversions occurred about the middle of July while a marked decrease in return flow was not shown at Vernalis until the middle of August which indicates a lag of about one month. With an assumed lag of one month between the diversions and the return, a comparison, of passing interest, is made between the total return during August and

September and the total diversions during July and August.

The combined diversions from the four rivers applied to the area tributary to the return flow at Vernalis were about 375,000 acre-ft. in July, 1922, and about 135,000 acre-ft. in August, 1922, or a total of 510,000 acre-ft. The total return at Vernalis including diversions during August and September, 1922, was 99,000 and 59,000 acre-ft., respectively, or a total of 158,000 acre-ft. With the assumption of lag as indicated above, the return was approximately 31 per cent of the diversions.

During the month of August and the first 23 days of September, 1923, the average flows of San Joaquin



River at Vernalis were approximately 1,470 and 1,090 sec.-ft. respectively. The flow during the last seven days of September, 1923, was affected by rains and by waste from the Don Pedro Reservoir and does not indicate the actual return. These records indicate an increase over the flow of 1922 of about 6 per cent in August and about 39 per cent in September. A complete record of diversions during 1923 is not yet available, but it is likely that considerably more water was diverted during the latter part of the summer on account of the availability of impounded water in the Don Pedro Reservoir on Tuolumne River, which was completed early in 1923.

The return water reaching Tuolumne River is largely derived from water diverted from the same stream. By comparing the relative areas irrigated from the Tuolumne and San Joaquin Rivers along the San Joaquin between Crows Landing and Vernalis, probably two thirds of the accretion to this latter stream is due to drainage from lands irrigated from the Tuolumne. Probably some of the area irrigated from Tuolumne River drains into Stanislaus and Merced Rivers, but it is thought that the seepage from this source into the latter two rivers is comparatively slight.

During 1921 and 1922 the average amounts of water diverted from Tuolumne River for irrigation varied from a maximum of about 3,000 sec.-ft. in May, to 1,850 in July and 250 in September. The return water during September from this source, neglecting any return that may find its way to Merced and Stanislaus Rivers, approximated 500 sec.-ft. during 1921 and 1922. The time of return will lag behind the time of diversion, but the return in September was greater than 25 per cent of the average diversions throughout the irrigating seasons of these two years.

It will be interesting to observe what effect the completion, in 1923, of the Don Pedro Reservoir on the Tuolumne River, with a capacity of 289,000 acre-ft., will have upon the gross amount of return water from this source, particularly during the latter part of the summer.

A larger percentage than that indicated above could be recovered in the Tuolumne River territory by resort-

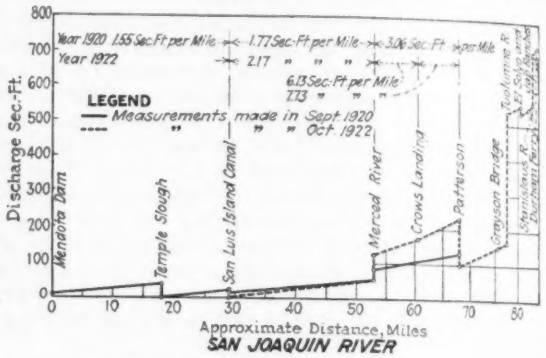


FIG. 2—CURVES OF RATE OF RETURN FLOW ACCRETIONS ON SAN JOAQUIN RIVER AND FOUR TRIBUTARIES

ing to increased pumping in the area where the water table is sufficiently close to the ground surface to cause large losses by evaporation. Pumping would cause the water table to be lowered and would prevent capillary action from subjecting the water to this evaporation loss.

The accompanying accretion charts indicate in detail the effect of return water upon the dry-weather flow of San Joaquin, Tuolumne, Stanislaus and Merced Rivers and Dry Creek. Dry Creek before the development of the Modesto, Oakdale and Waterford Irrigation Districts in that vicinity, was not a living stream during the summer. The accretion chart for Dry Creek indicates a minimum dry-weather flow of about 40 sec.-ft. during 1921 and 1922, at a point near its mouth. The measurements from which the accretion charts were prepared were all made during the latter part of the summers of 1920, 1921 and 1922.

The accompanying sketch map indicates the relative locations of the places of measurement of discharges that have been used in preparing the accretion charts. The map also indicates the location of the irrigated areas in that vicinity. The data used in preparing these charts were collected by the writer for the Division of Water Rights, State Department of Public Works and may be found in tabulated form in Bulletin 1 of that division.

Full development of the Kings River area, as has been proposed, will necessitate pumping from ground water to supplement the surface supply from the river. Therefore the recovery of seepage water will eventually be of vital importance in this area. The direct precipitation in this area is small and probably does not directly contribute to the ground water supply to any

material extent. An analysis of this situation results in an estimate that the Pine Flat Reservoir site, constructed to a capacity of 600,000 acre-ft., would control and make available for irrigation an average of 1,600,000 acre-ft. of gravity water each year during the irrigating season.

It has been assumed by those who have closely studied the situation that the ultimate demand below the Pine Flat Reservoir will be 2,000,000 acre-ft. each year, which is about 2.5 acre-ft. per net acre, since the total irrigable area is nearly 1,000,000 acres, of which not more than 80 per cent will likely be irrigated during any year. The consumption use will probably not exceed 2 acre-ft. per acre. This will allow for more than 300,000 acre-ft. per annum to percolate below the plant roots, which will be available for pumping. Seepage from the river bed also adds to the underground supply, particularly during high stages.

Records of diversions from this river, that have been kept in recent years by the Kings River water master under the direction of the State Division of Water Rights, indicate that during the latter part of the summer the total combined diversions are considerably in excess of the total flow of the river at the edge of the foothills.

The importance of seepage water in the Tule River area in Tulare County is indicated by the fact that the gross pumping draft in this vicinity during 1921 was approximately 132,000 acre-ft., whereas the average annual runoff of Tule River is about 137,000 acre-ft. The portion of this amount that leaves the Tule River area without use and spills to Tulare Lake has been estimated to average 17,000 acre-ft., in Bulletin 3 of Division of Engineering and Irrigation, State Department of Public Works, published in 1922. This indicates that the net mean annual available runoff is about 120,000 acre-ft. A certain portion of the gross draft will again percolate to the ground water table, in other words, the same water is used more than two times, which tends to offset the above indicated depletion of the ground water supply in this area.

On the area included within the delta of the Kaweah River, the total net pumping draft during 1921 was approximately 162,000 acre-ft. It is estimated in the above mentioned Bulletin 3 of Division of Engineering and Irrigation that the mean annual runoff of Kaweah River is about 451,000 acre-ft. of which an average of 55,000 acre-ft. passes across the delta without diversion or absorption, leaving a net mean annual water supply of 396,000 acre-ft. The pumping draft during 1921 was equal to 41 per cent of the net mean annual water supply and was nearly equal to the estimated average total annual recharge to the ground water of this vicinity. Increased draft upon the ground waters of the Kaweah delta would probably cause a lowering of the ground water level, unless there is provision for further replenishment.

Twenty years ago in the foothills to the east of the Sacramento valley, such small streams as Auburn Ravine, Antelope Ravine, Secret Ravine, Dotey Ravine and many others between Roseville and Auburn, normally had no flow during the summer and fall. In recent years, due to irrigation practiced from the waters passing through the Auburn power house, the above mentioned ravines are all living streams during the summer and fall with the water supply wholly derived from return water originally diverted from a foreign source. The importance of this return water is evidenced by the numerous filings before the State Division of Water Rights for appropriation of the water.

Along the Sacramento River the return water is being recognized today as a vitally important factor, since the present and proposed development on the river requires an amount of water considerably in excess of the natural dry-weather flow. In addition to the demand for irrigation, the matter of navigation enters into the situation on this stream. A prominent source of return water in this river is from the lands devoted to rice culture. A gross duty for this crop ranging from 5 to 18 acre-ft. per acre has been commonly used in the past. It is estimated from the results of experiments at the agriculture experiment station of the University of California that the actual consumptive duty represents a quantity on the average of about two-thirds of that diverted. The balance of the water returns to the river, but, of course, a certain portion of the return will occur too late in the season to be available for use again.

The maximum acreage planted to rice in the Sacramenta Valley was 154,000 acres in 1920, during which season the lowest recorded flow in the history of the Sacramento River occurred. In 1920, during the period June 1 to Sept. 30, the total discharge of the Sacramento River near Red Bluff was about 881,000 acre-ft. The total pumping draft from the river for this same period, between Red Bluff and Knights Landing was about 794,500 acre-ft., while the total discharge of the river near Knights Landing was approximately 272,400 acre-ft. It is estimated that nearly 31,000 acre-ft. of foreign water entered the Sacramento River above Knights Landing through Butte Slough between June 1 and Sept. 30, 1920. Subtracting this water from the discharge at Knights Landing and adding the total pumping draft, indicates an excess of 154,900 acre-ft. over the total discharge at Red Bluff. The gravity diversions from this section of the river are unimportant.

This excess of 154,900 acre-ft. was return water from Sacramento River irrigation, disregarding channel storage and evaporation from the water surface in the channel. The average drop in stage of the river between Red Bluff and Knights Landing during the above stated period was less than one foot, and therefore evaporation from the water surface in the channel more than offset this factor. The return water indicated above from Sacramento River irrigation was nearly 59 per cent of the total discharge at Knights Landing, and about 20 per cent of the total pumping draft for the period.

It is certain, due to the proximity of irrigated lands, that there are numerous other streams in California, the discharges of which are largely affected by return flows, but on which little reliable data are available.

The spreading projects in the extreme southern portion of the state may well be included under a discussion of return waters. These projects consist of the diversion and spreading of floodwater over porous lands through which the water percolates, and is held in underground storage, until its recovery is desired.

Various methods, such as pumping, collecting galleries and tunnels, are used to recover the water. Due to the flashy character of the runoff of many streams in this locality and to absence of economical surface

reservoir sites, spreading is the only practical method of making the floodwater available for use during the irrigating season.

Pending projects in California, as evidenced by filings before the State Division of W. er Rights, propose the development of an additional irrigated area of more than 9,000,000 acres. For a considerable portion of this area, no doubt, the water supply, even considering all available sources, is meager, to say the least. Therefore, a thorough investigation of the occurrence of return and seepage waters and the possibilities of their being made available for use, to supplement impounding of headwaters and direct diversion of natural flow, would be of vital interest to irrigation development.

Redevelopment Improves Output of Low-Head Power Sites

Output Restricted by Unregulated Flow—Head of Two Plants Combined—Installations Based on Flow Studies

By Henry W. Taylor
Consulting Engineer, New York City

FIVE paper mills at separate power sites on the Housatonic River are operated by the Smith Paper Co. of Lee, Mass. The gross heads at these power sites vary from 10 to 15½ ft., but the actual output falls short of the available power because of a lack of sufficient units for use at times of large flow in the river, and improperly proportioned units to take care of the low flows. Low output is due also to the fact that the waterwheels were built about twenty-five years ago at a time when the present refinements in waterwheel design were unknown. Since the original installations were made, the capacity of the individual paper plant has outgrown the available power at each

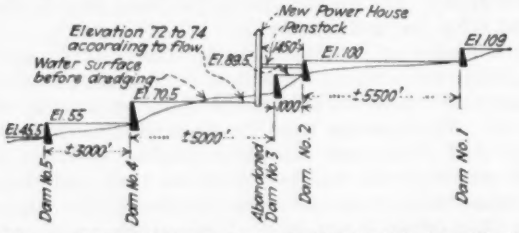


FIG. 1—PROFILE OF A PART OF HOUSATONIC RIVER
Showing dams of the Smith Paper Co.

location and it has been necessary to supplement the water power by the use of electric motors belted to the main shafts and supplied with current from outside sources. This combination drive by waterwheels and motors has proved troublesome at low-water stages, for, without careful operation, it may easily occur that the motors drive the waterwheels or at least accelerate their speed. Another source of trouble and waste of power comes from the fact that as the mills are not synchronized in any way, one mill may require much more water than is supplied by the plant above or may use less than is let down by the plant above. Also, when business is dull, one or more plants may be shut down and the power, which can only be developed by their direct-connected waterwheels, entirely lost.

Since 1920 studies have been made with the idea of using the power sites to develop electric power by the use of induction generators which would float on the line of the Pittsfield Electric Co., the company which now supplies the electric power purchased for the paper mills. Various combinations of two sites were considered, and it was finally decided to combine the heads available at mills 2 and 3 by building a power house below mill 3 and carrying the water from the dam at mill 2 to the new power house in a penstock.

TABLE I—NUMBER OF DAYS OF VARIOUS FLOWS
Years 1912-1922
Flow in sec.-ft.

Years	75	100	150	200	300	400	500	600	700	800	Over 800
1912–13	35	16	6	30	41	41	42	20	21	2	37
1913–14	55	68	27	42	49	19	12	9	9	2	51
1914–15	6	23	34	59	66	25	20	3	9		21
1915–16	9	39	58	43	64	36	26	9	4	10	59
1916–17	19	66	39	55	65	34	31	12	5		20
1917–18	66	73	35	21	22	17	21	9	13	3	31
1918–19	23	47	65	44	28	41	24	12	21	8	30
1919–20	20	80	42	47	52	24	12	14	9	4	52
1920–21	29	53	26	44	52	29	19	24	12	17	40
1921–22	31	24	42	88	56	30	16	14	12	7	38
Total	293	489	374	473	495	296	223	126	115	53	379
Average	29	49	37	48	50	29	22	12	12	5	38

At the site of mill 2 there is a gross head of about 10½ ft. and at mill 3 of 12½ ft., the working heads under average conditions being about 22 ft. when taken together. Mill 2 had a headrace about 300 ft. long and mill 3 had a headrace about 800 ft. long. Below the latter mill there were two riffles in the Housatonic River, the upper representing about 3½ ft. of head and the lower about 1½ ft. Taking the elevation of the dam at mill 2 as 100, the dam at mill 4 has an elevation of 70.5 ft., so that the removal of these two riffles by dredging would make the greater part of this total head of 29.5 ft. available for power purposes.

The waterwheels of mills 2 and 3 could not utilize more than from 350 to 450 sec-ft. of the flow, were of old design and low efficiencies, and needed replacement. Furthermore, in slack times, these two mills were the ones which were first shut down. Now, under the new arrangement, it is probable that within a year the machinery of these two mills will be set up elsewhere to reduce overhead expense and centralize the operations of the company in three mills instead of five without loss of the value of the power sites and their value to the other mills.

Flow Studies—Taking as a basis the flow records of the Housatonic River for the last ten years, the figures for the average flow which could be expected under various conditions, shown in Table I, were prepared. These figures were then used to estimate the amount of hydraulic power available under the various conditions of flow, head, and efficiency shown in Table II, from which the figures for electric horsepower-days in Table III were prepared. In the latter table adjustment was made for Sunday flows and their storage above the dam at mill 1 by means of drawing down the head at that dam on Saturdays. An estimate was also made of the output of the old wheels in the past in order to get a figure for the net increase in power output under the proposed conditions.

The new units are so arranged that use can be made of the gradually increasing flows without serious loss of efficiency. This arrangement is further augmented by the use of units intermittently at their best rate of production when the available water would not maintain

a uniform operation of one unit without loss of efficiency or loss of water.

In the case of full operation of all mills the new plant will reduce the total purchased power by about 50 per cent. In case of a curtailment of manufacturing, the contract with the Pittsfield Electric Co. provides for the sale of excess power to that company on a coal cost basis.

The power produced by the new station is flash power and suitable only for interconnection with a standby power to take up fluctuations of load and seasonal variations of the flow. In designing the plant a development curve was drawn showing the number of days on which any given flow of water would take place in the average year, and it was decided to discard flows above 750 sec.-ft. The development of larger flows introduced penstock sizes which reduced the net earnings out of proportion to the absolute gain.

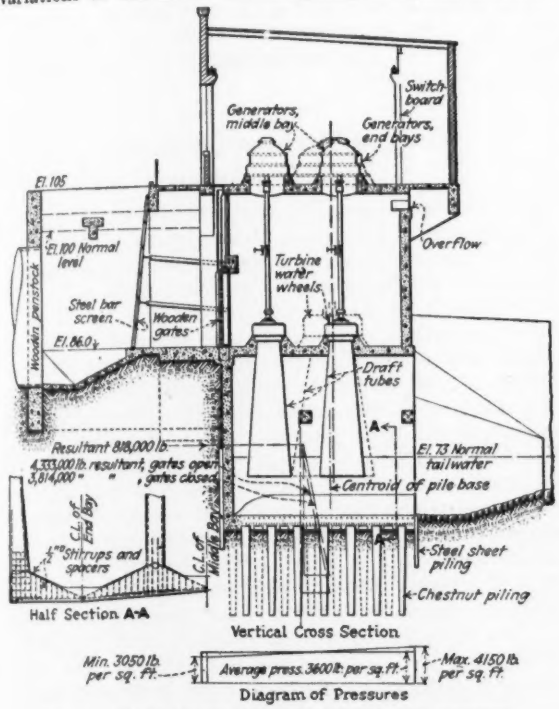


FIG. 2—CROSS-SECTION THROUGH THE POWER HOUSE AND FOREBAY
Showing details of foundation.

New Equipment—The hydro-electric equipment of the new plant consists of four vertical shaft generators and two motor-driven exciter sets. Two of the generators are of 600 kva. capacity and two are of 185 kva. capacity. All four float on the lines of the Pittsfield Electric Co. through transformers which step the voltage up from 2,300 to 20,000 volts. Under this arrangement the governing of the wheels represents a problem of preventing over-speed only. For this purpose four air cylinders having pistons equipped with racks to act on the gate-shaft gears were installed. The air supply is controlled by valves at the switchboard. The waterwheel gates are set to accommodate the amount of water available at the time and a mechanical ball governor opens an air release valve in case of over-speed and the gates are closed by an air cushion maintained on the closing side of the operating piston. Over-speed occurs only in case the Pittsfield circuits are dead or a breaker kicks out.

New Construction—A section of the dam at mill 2 was cut away and a concrete intake channel constructed from which a wood-stave penstock 11½ ft. in diameter and 1,450 ft. long extended to the forebay of the new hydro-electric plant at mill 3. The intake channel consists of a new concrete wall, a long wooden baffle and headgates. The cross-section area of this channel reduces gradually from an enlarged section at the outer end to the width of the new penstock. The penstock is laid on wooden sills and buried for about half its depth, the excavated material being hydraulically backfilled along the pipe line. The pipe was sprayed with creosote and painted with asphaltum before backfilling was started. The outlet end of the penstock consists of a tapered section 40 ft. long in which the diameter increases from 11½ to 16 ft. and the water velocity is reduced about one-half.

The new power house has concrete foundations and a brick superstructure. The wheel pit floor at El. 86, or 14 ft. below the head-water, is supported on three arches with walls to the tailrace floor, the latter being at El. 64. The operating floor is at El. 105 and is supported by similar arches and walls from the wheel pit floor. The south or downstream wall of the wheel pit and the upstream face of the draft-tube chamber have horizontal arches between the walls supporting the floors. It was originally planned to use the forms for these arches four times, but it was found impracticable to remove them intact, and consequently only the centers were so used.

The two small 200-hp. wheels are installed in the same wheel pits and the two 700-hp. turbines are each in a separate pit. Above the wheel pit is a forebay with a screen 18 ft. in height and a screening platform across the full width of the forebay. Headgates for each section of the wheel pit are provided inside the line of the power house where they can be raised and lowered by the power-house crane. They are so dimensioned that in their lifted position they do not come above the floor of the power house. These gates are plain baffles without posts or rack-and-pinion lifting apparatus, and it has been found that they must be weighted to prevent jumping at times of water surge.

When the cofferdam for the power-house foundation

TABLE II—REDUCTION OF SEC.-FT. FLOWS TO ELECTRIC HORSE POWER OUTPUT

Efficiencies under various loads

	Percents		
	100	75	50
Small Generator	90	88	84
Small Wheel	88	22	75
Total	79	72	63
Large Generator	92	92	90
Large Wheel	90	85	80
Total	82	78	72

Flow	Units in Use	Eff.	Head	Elec. hp.
25	1 small	63	28*	58
50	1 small	63	28	100
75	1 small	79	28	188
100	2 small	70	28	224
150	2 small	80	28	380
200	1 large	78	27.5	487
300	1 large and 1 small	80	27	733
400	1 large and 2 small	80	27	980
500	2 large	80	26.5	1,200
600	2 large and 1 small	82	26	1,450
700	2 large and 2 small	80	26	1,650
800	2 large and 2 small	78	25	1,770
Over	All Units plus Niagara-Centennial			2,200

* Small flows to be stored and machine run intermittently.

was excavated to nearly its full depth a form of quicksand was found in the east end. The remainder of the excavation was in hard clay and boulders. When the quicksand was discovered excavation at that end of the cofferdam was stopped at an elevation about 1 ft. higher than originally planned for fear of cutting

FIG. 3—DREDGING THE TAILRACE

through into a pocket of real flowing quicksand and losing the whole excavation and cofferdam. To render the two classes of bottom of equal bearing value, it was decided to pile the whole area using the same weight of hammer and driving the piles to the same resistance throughout. The change to the use of piling required the redesign of the tailrace floor in order to spread the load of the end and intermediate walls

TABLE III—ELECTRIC HORSE POWER OUTPUT REDUCED FROM AVERAGE HYDRAULIC CONDITIONS
Years 1921-1922

Flows Sec.-Ft.	Days	Rate Elec. hp.	Elec. hp.-days.	
25	11	50	550	
50	23	100	2,300	
75	29	188	5,450	
100	49	224	11,000	
150	37	380	14,070	
200	48	487	23,350	
300	50	733	36,700	
400	29	980	28,400	
500	22	1,200	26,400	
600	12	1,450	17,400	
700	12	1,650	19,800	
800	5	1,770	8,850	
Over	38	2,200	83,500	
	365		277,770	277,770
Sunday Flows				
Store up to 200 sec.-ft.		Elec.hp.	Elec. hp.-days	
Lose	7 days at	224	1,680	
	4 days at	487	1,950	
	3 days at	733	2,200	
	2 days at	1,450	2,900	
	1 day at	1,650	1,650	
	1 day at	1,770	1,770	
	5 days at	2,100	10,500	
			22,650	22,650
				255,120
Deducting present use of wheels				46,900
Net increased output				208,220 Elec.hp.-days. or 3,740,000 kw.-hr.

throughout the piled area and reduce the bearing per unit to a minimum. Fig. 2 shows the load and bearing values and the method of floor construction used. About 40,000 lb. of reinforcing were required for this new floor and to tie all parts of the structure to the forebay to counteract all water pressures except those opposite the penstock inlet, and to brace the structure against unequal settlement. Check levels taken after the power house had been completed and with the full water pressure with the gate closed acting upon the power house showed that no settlement had taken place.

Below the power house the bed of the Housatonic River was dredged for a distance of about 2,000 ft. and to a bottom width of 55 ft. About 12,000 yd. of material were removed from the river by a small stiff-leg derrick, shown in Fig. 3, mounted on a traveler, one rail of which followed the shore line and the other lay in the river, the derrick operating on the river side and behind the rig.

Geared Turbine Locomotive Built in Scotland

AMONG the more important exhibits at the British Empire Exposition is an experimental Reid-MacLeod geared turbine locomotive constructed by the North British Locomotive Co., Ltd., of Glasgow. The locomotive is briefly described in the Oct. 3, 1924, issue of *Engineering*, London. Except for part of the top of the boiler and stack, which appear above the side plates of the locomotive at the rear, it bears little resemblance to the ordinary steam locomotive. Its appearance is more like that of an elongated electric locomotive. There is no tender, the whole engine being mounted on a single rigid frame, carried by two compound truck units. The front end is occupied by the condensing plant, the cab is in the center, and the boiler, fitted with a forced draft fan and superheater, is at the rear. Each driving unit consists of a four-wheel truck on the outer end and two pairs of geared drivers propelled by a steam turbine unit set longitudinally on the frame above the drivers. The high-pressure turbine is connected to the rear unit and the low-pressure turbine to the forward unit.

The boiler is of standard locomotive type with superheater. The condenser is of the air-cooled evaporation type. Spraying nozzles across the open front end of the condenser casing deliver a spray which is carried over the condenser pipes by the natural flow of air when the locomotive is in motion and by a draft induced by fans when standing.

New London Traffic Act in Force

The London Traffic Act, which received royal assent just before Parliament rose for the summer recess, has become operative. The act, which is an attempt to relieve the congested state of the streets, deals with an area of a radius of 25 miles from Charing Cross. Its main feature is the setting up of an advisory committee to investigate and report on any matters relating to London traffic. Other provisions deal with the better co-ordination of street works, the licensing of and limitation of the number of buses on certain approved routes, the prescribing of certain bus routes, and the holding of inquiries into street accidents. The Minister of Transport is empowered to formulate regulations limiting the amount of traffic on any particular route, and he may also prohibit vehicles of a specified class from using certain streets.

Hollow Concrete Bridge Piers Built Like Chimneys

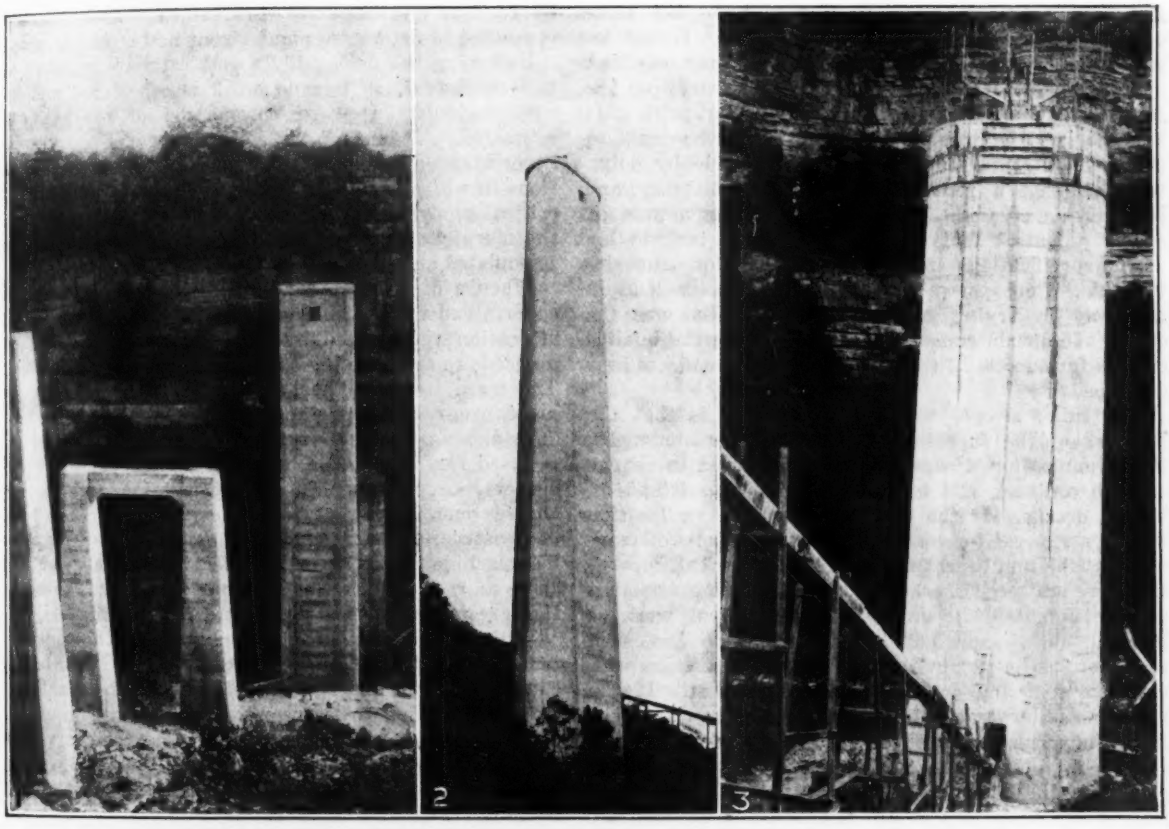
Piers 181 Ft. and 221 Ft. High of Reinforced Concrete to Carry Highway Bridge Over Dix River Gorge

TWO TALL hollow concrete piers have recently been built to carry a road bridge across the pond which will be formed by the Dix River dam in Kentucky. This dam, 370 ft. high and one of the remarkable rock-fill structures of the country, will pond the deep and narrow gorge of the Dix River for a distance of 33 miles. The bridge is located five miles above the dam and about four miles from the little town of Burgin, Ky. Here the gorge is about 250 ft. deep, one bank being a nearly vertical cliff and the other a steep bluff as shown by Fig. 1, in which the third and fourth piers are the ones calling for description.

These piers are hollow reinforced-concrete tubes—virtually chimneys. Indeed they were built by the Weber Chimney Co., of Chicago, by its regulation chimney-building process, and designed by the company engineer in conjunction with L. F. Harza, chief engineer of the Dix River dam and hydro-electric development. The larger pier is nearest the cliff in Fig. 1, and is 221 ft. 9½ in. high. Its foundation is a 35-ft. square slab 6½ ft. thick reinforced 6 in. from top and bottom with 1-in. round bars. The shaft is anchored to the foundation by 1-in. and ¾-in. vertical bars. It is 28 ft. 4¾ in. x 18 ft. 4¾ in., with a shell thickness at the bottom of 26¾ in. The horizontal reinforcement is ¼-in. rods spiraled, with a pitch of 12 in., around the outside of the vertical bars. The smaller pier is 181 ft. 5½ in. high on a 30-ft. square footing 5½ ft. thick.

Both piers are founded on solid rock. Both are 12 ft. wide and 22 ft. long at the top, both have a reinforced-concrete slab top, and both have 3-ft. square shell ports at top and bottom to permit them to fill with water when the pond is full. The sides are flat and the ends are round and both sides and ends taper toward the top and the shell thickness also decreases from bottom to top. Between the flat faces, inside, every 45 ft. in height there is a transverse 12x30-in. reinforced-concrete beam.

Both piers were built by the same method indicated by Fig. 3, which shows the highest pier under construction at a height of about 110 ft. Regulation Weber chimney forms were employed in 4½-ft. rings; two rings were used, each being alternately filled and lifted above the other. To reduce the cost of getting concrete materials to the pier bottom down in the gorge, the mixer was located about 300 ft. away and 70 ft. up-hill and the concrete was chuted 250 ft. to the bottom, Fig. 3, and hoisted inside where all the scaffolding was located. Two hoists were used. The concrete mixture was 1-in. stone, with fine crushed stone for sand, the proportions being determined by field tests.



HOLLOW CONCRETE PIERS FOR DIX RIVER BRIDGE

Fig. 1—General view of substructure. Fig. 2—Pier 181 ft. high completed. Fig. 3—Pier 221 ft. high in progress.

An Interview

With W. A. ROGERS
President, Bates & Rogers Construction Co., Chicago

A Construction Superintendent's Duties and Training

By C. S. HILL
Associate Editor, Engineering News-Record

"To Superintend" Is His Chief Business—The Qualifications Required for Success—Best Results Secured by Training Inside the Organization

A CONSTRUCTION superintendent is a contractor with only one job. He should have the same organization and his delegated authority should be nearly as complete. This calls for a man of high qualifications. The superintendent is primarily on the job to make a profit for his employer but with this task he has the welfare of a continuing business to conserve. Profits must, therefore, be made by doing work so that a reputation for skill, reliability and integrity is created. This again calls for a man of special talents. It is not, then, a small task to lay down specifications for good construction superintendents. Perhaps we can accomplish it as well as in any way by trying to answer: (1) What are the duties of superintendents? (2) What are the qualifications for success? (3) How are superintendents best developed?

One thing always to be kept in mind is that the business of the superintendent is to superintend. In this organization a superintendent is placed in charge of each contract, and he is given proper assistants to handle details. If the operations are in one location he has a general foreman on whom the details of management fall and to whom the foremen report; if operations are scattered there may be one or more assistant superintendents. In any event all clerical work is handled by a superintendent's clerk, who has such assistants as he requires and to whom the timekeepers, material men and commissary clerks report. If the operation is large an engineer is assigned to the superintendent. This assistant measures the work performed and checks up the quantities and classifications as reported by the client's engineers. He also makes such plans and calculations as are required and designs any structures that are needed. By such an organization of assistants, expanded or contracted as satisfies the occasion, the superintendent is left free to apply himself to the major problems of management.

Duties—The duties of superintendents fall into two categories: (1) Making the estimate and preparing the bid; (2) Organizing and directing construction operations.

As soon as it is decided to make a bid for any construction operation a superintendent is tentatively assigned. His first task is to make a field study and in this he is usually assisted by others of the general organization who can bring experience and skill to the consideration of the various problems. The site of the work is carefully investigated in detail, and methods of planning and handling the work are studied. Available local supplies of building and other materials are investigated and then the possibilities of outside material supply and delivery are comparatively studied. Local labor supply and wages, local markets and prices of materials and supplies, local transportation conditions by road and railway are ascertained. Then the site is studied to determine plant layout and a plan of work.

Following the field study a cost estimate in detail is undertaken. Each item of work is considered and its cost, including a proper proportion of overhead, is estimated. Then there is a conference of executives, superintendents, engineers and others of the organizations in which each item of the estimate is subjected to critical analysis. A revised estimate is then drafted, the margin of profit desired is added and the bid is formulated and presented.

When a contract is secured, it will be observed, the superintendent has intimate knowledge of every consideration represented by the bidding prices, and he proceeds to organize his operations with foreknowledge. The main items he has to consider are: Personnel, plant, progress, records and direction of work.

In picking the field organization the superintendent, first, so far as possible, selects foremen, clerks, timekeepers, etc., from within the organization, and, second, chooses men having particular experience in the kind of construction being undertaken. If he can, he gets his machine operators and skilled workmen from the same source. In brief, men trained inside the organization are utilized to the greatest extent practicable.

With the nucleus of his organization, the superintendent gets into the field, picks his camp sites, builds camps, puts his roads in shape and gets the plant and materials coming to the work. Generally in preparing the bidding prices the plant units and their arrangement have been determined. The field task is assembly. Units in stock are utilized first and new units are bought where needed. Plant layout and assembly are most carefully planned as in these days of machine operations the success of the work depends largely on equipment efficiency and plant arrangement.

Finally the big duty of the superintendent is to lick his organization into shape and to keep the work lined up. Among his aides are progress schedules and performance and cost records. As soon as possible after getting work started a progress schedule is made out. This schedule is a good thing even though contingencies may make necessary some revisions of dates. In order to make out the schedule the superintendent must necessarily plan the job through. The schedule is a time table. It tells the next move ahead. It is a pacemaker for the men. It is a guide for the main office. Performance and cost records are equally serviceable tools.

Little not already said can be said of the necessity to the contractor of cost keeping. The superintendent has a duty in addition—he has to keep a personal cost check. Each superintendent will naturally have his own special plan of doing this but in all cases it

amounts to some field method of rapidly detailing costs so that every day's costs can be checked up on that day with every previous day's costs in all details. In no other way can the superintendent so well keep his fingers on the pulse of the operation. Besides costs, a log of operations is required. This may well be a running history containing all orders or instructions exceeding the routine which are received or given, statements of unusual occurrences affecting the work and accounts of disputes over any detail of the operation which later may play a part in settling the final estimate.

In many ways records can be made to play an important part in works superintendence but withal the big duty of the superintendent is the exercise of that intangible influence which keeps the work going along with a swing and the client pleased with the results. Keeping the client's engineer ahead with his plans and instructions, seeing that estimates are put through and payments kept regular, keeping materials shipment prompt and regular, keeping down waste in effort as well as in time, materials and supplies, keeping labor satisfied, keeping good relations with client and the public are a few of the scores of duties which the good superintendent is required to perform.

Qualifications—Without any further outline of duties it is clear that very pronounced qualifications are required of a good superintendent. Some of these are hard to define; others can be stated definitely. They are a good business head, practical engineering sense, quick decision, diplomacy, character, address, observation, loyalty, responsibility, and persistence—in brief the qualifications of a managing executive.

Construction is constantly calling for business judgment. To determine whether a certain action, or an alternative, will pay best requires keen business instinct. Planning not only how to construct but how to construct in the quickest and cheapest way demands practical engineering ability. Both business and engineering problems often call for quick decision and when emergencies arise prompt action only may avert disaster. It is the business of the superintendent to get along with the men who work for him and for whom he works—it costs money to be at variance.

In the end, however, there must be more than technical and business qualifications. A truly successful superintendent must be a man of good habits, of good moral character, and have high ideals. He must realize that honesty is not only the best policy, but is right, and that it pays to have the reputation of doing honest work. The old idea that a contractor, in order to be successful, must be what is known as a good fellow, inclined to drink, and do other things that he should not, in order to entertain the engineers and others, is obsolete. Any amount of drinking with a man or entertaining him will not help in attaining success; but, on the other hand, may have just the opposite effect.

A good address is a valuable asset. While appearances are only on the surface, sometimes the first impression made by the outward appearance is of vital importance. If practicable the ability to express one's ideas clearly and forcibly in good language is invaluable.

The longer I live the more I am impressed with the importance of being able to talk convincingly on one's feet. The ability to go on a job and take it all in is also important. The habit of observation should be cultivated. Loyalty to the employer is, of course, essential. If one is not in sympathy with the people he works for, he should get out. The superintendent should be constantly striving to widen his acquaintance with engineers, contractors, and others with whom his company may later have business relations. He must always keep his eyes open to see how the other fellow does his work, ever ready to select better methods than those he is using. In doing this, he broadens his viewpoint and becomes a better engineer.

"I have left to the last two of the most important qualifications, without which I believe it is impossible to become successful. The first is the willingness to assume responsibility. It is far better to do something and do it wrong than to do nothing. The man who is always waiting for some one to tell him what to do and how to do it does not get anywhere. Take responsibility and put all that there is in you to do right what you have assumed to do. The other qualification is what I call "stick-to-it-iveness." The quitter should never enter the contracting game for there is no place for him in it. What is wanted is the man who does the thing he starts out to do, in spite of good reasons why it cannot be done; who does not know when he is beaten; who does not know how to quit. If there is a "yellow streak" or quitting streak in a man, he should never start in a career leading to that of a contractor's superintendent. We have in our organization men who when they set out to do a task do it. We simply forget that it is to be done and assume that it is as good as done when it is turned over to them. That is the kind of man wanted as superintendent and that kind of a man is bound to succeed."

Training—How can men best be trained for this responsible position of superintendent of construction?

This organization believes that the best way to train the men is inside the organization—from the bottom up. Thus they become familiar with the duties of the men in the various steps of progress upward; they become saturated with the ideals of the organization; they become familiar with its particular methods of handling work and its system of cost records, they get to know the men of the organization. The future superintendent may start as timekeeper, or commissary clerk or foreman or laborer or office clerk—if he has the qualifications his starting point is immaterial.

Preference in Immigration To Be Tested

An effort is being made in the South to determine the value of the preference granted by the immigration act to farmers in connection with settlement of cut-over lands. An application has been filed by the Department of Labor seeking the admission of one hundred Germans, who will qualify before American consuls as skilled farmers. If the plan works well with those who will be brought in under this application, it will be extended. Since the number of persons in most European countries who are desirous of coming to the United States is greatly in excess of the quota, it is believed that out of the total number a considerable number of immigrants of bona fide farm experience can be selected. The preferential rights granted by the law constitute an inducement to such immigrants, since they are insured of entrance at any time. The lumber companies and other owners of unused lands believe this plan will help to secure desirable settlers.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Beam Deflections by Coefficients

Sir—Referring to the article "Beam Deflections by Coefficients" written by C. B. Dannenberg in *Engineering News-Record*, Oct. 2, 1924, p. 558, the writer believes there should be a correction in the last formula in his article which reads:

$$\text{Deflection} = \frac{9{,}000\ (20 \times 12)^3}{48 \times 29{,}000{,}000 \times 215.8} + \frac{5\ (12 \times 31.8)\ (20 \times 12)^3}{384 \times 29{,}000{,}000 \times 215.8} = 0.424 \text{ in.}$$

when it should read:

$$\text{Deflection} = \frac{9{,}000\ (20 \times 12)^3}{48 \times 29{,}000{,}000 \times 215.8} + \frac{5\ (20 \times 31.8)\ (20 \times 12)^3}{384 \times 29{,}000{,}000 \times 215.8} = 0.432 \text{ in.}$$

The illustrative problem in Mr. Dannenberg's article uses a span of 20 ft., therefore 20 instead of 12 would have to be used in the calculation to satisfy the W in the formula

$$D = \frac{PL^3}{48EI} + \frac{5WL^3}{384EI}.$$

C. R. COOKES.

Columbus, Ohio.
Oct. 14, 1924.

Insulating Oil Storage Tanks Against Fire

Sir—The editorial appearing on p. 529 of the Oct. 2, 1924 issue of *Engineering News-Record* calls attention to an important problem before municipalities and petroleum distributors. The Monterey fire is only one of a large number of catastrophes, many of which did not obtain the publicity of the recent fire but nevertheless contributed to the annual loss of property and of natural resources.

Although the extent of damage done by the Monterey fire has been rightly attributed in part to the lack of proper dikes or protecting walls to prevent the spread of burning oil, I would like to call attention to the part played by fire-resistant insulation in similar conflagrations. In most cases the greatest destruction occurs after a tank of burning oil boils and overflows, thereby heating and igniting the contents of surrounding tanks. The use of heat insulating materials which can withstand the intense heat of burning oil reduces to a great extent the possibility of ignition as the temperature of the stored oil is not raised to a high point. In other words, by the use of fire-resistant insulation, the fire may be localized and retarded sufficiently to prevent the ignition of other storage tanks.

This function of tank insulation should be differentiated from its effect on evaporation losses. There are materials and constructions available for insulation against evaporation but the full economy of such construction is not utilized unless the materials used are at the same time of sufficient fire-resistant characteristics to withstand intense heat. The difference in two insulating materials was vividly demonstrated during a fire at a small local refinery having two adjacent storage tanks insulated with different materials. One tank insulated with a material employed extensively for steam pipes although not ignited, was badly warped from the heat and the insulation practically fell off due to disintegration, while the other tank covered with a material resistant to 1,800 deg. F. only required a new covering of canvas to be placed in its original form.

Another instance in which great losses were prevented by the use of fire-resisting insulation (Sil-O-Cel) occurred at a southern California absorption plant at which more than 30 tanks, 30x10 ft., were used for gasoline storage. The fire originated in a retort and burned around the tanks and dephlegmators, being fed by sump and drainage oil, but no explosions or serious damage occurred although a few of the units were exposed to a high heat.

The study of fire preventive measures should include the study of insulation materials, fire extinguishing chemicals and automatic appliances and the advisability of formulating restrictions as to the size of storage units.

C. A. MIKETTA,
Technical Department, Celite Products Co.

Los Angeles, Calif.,
Oct. 13, 1924.

Level Rod Does 41 Years of Service

Sir—Goyne Drummond, an engineer of this city, brought to my office this morning a Philadelphia level rod which was broken on Oct. 22 by hitting a bridge truss as it was being carried in an automobile. Mr. Drummond states that he bought this rod in Denver in 1883, but does not recall the manufacturer or dealer of whom he purchased it. It has been in almost continuous use for 41 years and the wood, which is believed to be wild cherry, is still in first-class condition. It is thought that this may constitute a world's record for active life of a level rod.

H. D. COMSTOCK,
Project Manager, Riverton Project,
U. S. Reclamation Bureau.

Riverton, Wyo.,
Oct. 24, 1924.

Hydraulic Notches for Channel Control

Sir—I have read with much interest the letter signed "Cusec" in your issue of Oct. 16, p. 641. I was quite aware that the hydraulic notch was not a new thing. It is mentioned in several textbooks on irrigation works, notably in "Practical Design of Irrigation Works" by the late W. G. Bligh, where a method of calculation is given, as a means of velocity control above canal falls. My article was merely intended to give a simple and practical method of calculation. Incidentally, the article mentioned (Aug. 7, 1924, p. 232) and illustrated its application to flumes and inverted siphons; the application to canal falls was not mentioned.

Canals in India are generally built with a much smaller ratio of depth to bed-width than is usual or possible under American conditions. The best ratio is very largely a function of the cross slope of the country, and when this is or may be large, the ratio must be comparatively high. Where the ratio is small, the depth and the hydraulic radius are not very much different, but this is not the case if the ratio is large. In the former case the discharge will follow the five-thirds power of the depth very closely; it will not do so in the latter.

The original object of the notch was control of the velocity above canal falls, and at the same time to subdivide the stream or jet in order to simplify the problem of its reception in the canal below. For the latter purpose it seems to have worked very well, in India. The result in western North America was not so happy. A plurality of notches proved to be an excellent trap for floating trash; but if the subdivision is abandoned, the primary object of the subdivision goes with it, at least for canal falls. A way out of the difficulty is to construct one or two notches some small distance above the crest of the fall, and allow or force the issuing jet to spread out into a thin sheet which can be received below without much difficulty.

It might be noted that in the case of canal falls, conservation of energy is no part of the problem. In the case of flumes and inverted siphons, conservation of energy may be the essence of the problem, and it was this idea which was stressed in the article.

H. B. MUCKLESTON,
Consulting Engineer.

Vancouver, B. C.
Oct. 22, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

One of the Seven Members of the commission recently appointed by the mayor of Baltimore to draft a new charter to be submitted to the voters of that city in 1926 is William W. Pagon, consulting engineer. The chairman of the commission is B. H. Griswold of the banking firm of Alexander Brown & Sons.

The Fourth Annual Ohio conference on water purification with the state department of health meets Nov. 12-14 at Hotel Gibson, Cincinnati. Topics include experience with the new softening works at Newark, with double coagulation at Toronto, Ohio, with sodium aluminate as a coagulant, with pebble quick lime and double chlorination.

Electrification of the Suburban Lines of the Pennsylvania R.R. from Philadelphia as far south as Wilmington, to be followed by the electrification of the New York & Schuylkill Division, is reported to be part of the plan of the Pennsylvania R.R. for improvements in and around Philadelphia incident to the building of the new station, announced in *Engineering News-Record*, Oct. 23, 1924, p. 682.

The First 15,000-Unit of the Minnesota Power & Light Co. at Fond-du-Lac on the St. Louis River near Duluth has been put into service. It is part of the $20,000,000 improvement program being carried out by the Phoenix Utilities Co. in that region. Another project in this development, that near Royalton, Minn., on the Mississippi River, is about 85 per cent complete.

Promising Applications of aerial photography are being made by the Department of Agriculture in the estimating of crop acreages. Photographs are made at an altitude of 3,000 ft., which gives sufficient detail to identify crops, and at the same time permits the covering of vast areas in the course of a few hours. The Department has developed special instruments which permit the automatic calculation of the acreage in irregular areas.

Two Stone Jetties are to be built at the mouth of the Magdalena River by the Colombian government. Each jetty is to extend out from the shore to the 10-m. contour (33-ft. depth), a distance of approximately ¾ mile. The jetties are for the purpose of deepening the channel through an existing sand bar. They are to be built of an average weight of 1½ tons each, stone to be brought from quarries about three miles up the river. The estimated cost of the project is $3,500,000.

Joint Committee on Concrete Report Available

The final report of the Joint Committee on Concrete and Reinforced Concrete, which contains the standard specifications for concrete and reinforced concrete, has been approved by the committees of the constituent societies and was published in the October Proceedings of the American Society of Civil Engineers. Copies may be obtained from the American Society of Civil Engineers, 29 West 39th St., New York City, or the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa., at a price of $1.50 for non-members of the society and $1 for members of the society.

The Am. Soc. C. E. publication will not be available until Dec. 1, at which time the report on the Camden and Newark Bay tests on concrete structures under construction will also be available.

More U. S. Funds Wanted for River Control Studies

A determined effort is being made to secure the re-enactment of the law which authorized the President to name a commission to make comprehensive river studies along the lines advocated by the late Senator Newlands of Nevada. O. C. Merrill, executive secretary of the Federal Power Commission, points out that the law providing for the Newlands commission was repealed by the water power act and contends that the Federal Power Commission has all of the authority necessary to make comprehensive studies of all rivers. All that is required is the enabling legislation which would permit this use to be made of the fees collected from the power companies. At present these fees are going into the treasury listed as miscellaneous receipts.

The pressure for the re-creation of the Newlands commission comes largely from New Orleans which is aroused anew over the matter of flood levels by the initiation of the levee work which will close a seven-mile gap just north of Red River, and by the announcement of the Mississippi River Commission that it is about ready to begin leveeing tributaries as far up as they are affected by the flood waters of the Mississippi. It is contended that this curtailment of reservoir area in times of flood will result in higher gauges below Red River. Mr. Merrill's contention is that there is great need for comprehensive river studies which necessarily will include all rivers, even those not possessing actual power sites, as they will be affected by head-water storage or diversions.

W. W. Atterbury Promoted by Pennsylvania R.R.

Samuel Rea, president of the Pennsylvania R.R., has announced the promotion of Gen. W. W. Atterbury from the position of vice-president in charge of operation to that of vice-president, a new position created by the directors at their recent meeting. It is expected that General Atterbury will become president of the Pennsylvania system when Mr. Rea retires next September.

General Atterbury was born at New Albany, Ind., in 1866, completed his education at Yale in 1886, and entered the employ of the Pennsylvania R.R. the same year as an apprentice at the Altoona shops. He progressed through the positions of master mechanic, superintendent of motive power and general manager of lines east of Pittsburgh, until in 1909 he became fifth vice-president in charge of transportation, and two years later became a fourth vice-president and a director of the company. In 1917 he entered the army, and from late in 1917 to May, 1919, was director-general of transportation of the American Expeditionary Forces in France, with the rank of brigadier-general. At the time of the termination of federal control of the railroads in 1920, General Atterbury became vice-president of the Pennsylvania R.R. in charge of operation.

Elisha Lee, vice-president of the central region with headquarters at Pittsburgh, has been promoted to succeed General Atterbury; E. T. Whiter, vice-president of the Northwestern region, succeeds Mr. Lee, and T. B. Hamilton, general manager of the Northwestern region, succeeds Mr. Whiter. Both Mr. Lee and Mr. Hamilton started railroad work as rodmen and Mr. Whiter as a telegraph operator.

Merger of Japanese Steel Plants Proposed

The Japanese government is now seriously considering a merger of all the government and private steel plants, according to a weekly cable to the Department of Commerce from Acting Commercial Attache Halleck A. Butts. This represents the culmination of a movement that commenced shortly after the war, when the private plants that were established during the boom period found themselves unable to operate under post-war conditions. The government plants have shown little or no profit for some time and the private establishments have been steadily losing money in spite of a heavy government subsidy. Consolidation is expected to eliminate unsound plants and increase general efficiency.

Chicago Diversion Decision Pivotal St. Lawrence Issue

Sanitary Problem Settlement Must Precede International Phase, Is Washington View

Washington Correspondence

Officials interested in the development of the St. Lawrence quite generally have come to the opinion that it is useless to discuss the matter with Canada until an agreement is reached between the federal government and the sanitary authorities at Chicago. This domestic difficulty must be ironed out first before any international progress is made, it is believed. The prospects of an agreement with Chicago are better at this time, it is stated, than ever before. There has been a decided change of attitude on the part of the sanitary authorities.

While the situation will be influenced unquestionably by the pronouncement of the Supreme Court of the United States when it hands down its decision in the diversion case, there is a feeling that an agreement which would reduce by 2,000 or 3,000 sec.-ft. the volume of water now being diverted from Lake Michigan would be acceptable to Chicago. This would bring the total diversion to 5,000 or 5,500 sec.-ft. Were such an agreement effected the United States then could propose some form of compensation for the slight damage that Canada could claim for this reduced diversion. It either could be used to offset the advantage which Canada enjoys at Niagara Falls or could be cared for in some other way.

Sentiment in Canada

In addition to the encouragement which has come as a result of Chicago's more conciliatory attitude there are numerous indications of changing sentiment in Canada. The opposition to the St. Lawrence project is receding, apparently. The public in the Dominion has been impressed by the volume of business passing through the existing canals and by this year's freight congestion. Also financial plans for the St. Lawrence development have been worked out to the point where it is apparent that no appropriations in money from the treasuries of either country will be necessary. One plan is to extend governmental credit through the issue of special bonds. The plants when completed could be leased for operation at an annual amount not less than the current commercial interest rate on the moneys invested. The difference between this rate and the interest paid by the governments could be used to retire the bonds.

There has been a very marked change in the outlook, it is declared. A month ago officials were inclined to view the situation pessimistically. Certain elements in evidence then led to the fear that the project was faced with a long period of international conversations. The assurances of the last week, however, have done much to expel that gloomy outlook and the prospects of the development, it was stated in a high official quarter, are better today than ever before.

New York-New Jersey Vehicular Tunnel Holed Through

The two under-river headings of the north tube of the New York-New Jersey vehicular tunnel under the Hudson River met on Oct. 29. The meeting point was 575 ft. west of the Manhattan pierhead line and 2,620 ft. east of the New Jersey pierhead line. The alignment, both line and grade, checked out very closely.

Preliminary checks on the alignment and grade have been run and when figures are released by the commission they will be noted in these columns.

It is expected that the headings of the south tube will meet in December and that both of the tunnels will be in operation in 1926.

The ceremony which was planned in connection with the holing through was abandoned on account of the death of the chief engineer of the tunnel commission, Clifford M. Holland.

Railway Bridge and Building Association Meets

At the well-attended convention of the American Railway Bridge and Building Association, recently held at Kansas City, the individual papers included the following: "Field Control of Concrete," by H. C. Boyden, Portland Cement Association; "Bridge Design in Relation to Maintenance," John L. Harrington, consulting engineer; "Rebuilding the Columbia River Bridge, Union Pacific Ry.," G. H. Trout, bridge engineer; "Bridge Work on the Kansas City Terminal Ry.," G. V. Hanna, chief engineer; "The Eads Bridge at St. Louis," C. E. Smith, consulting engineer, and "Fire Hazards of Treated Timber," C. S. Heritage, bridge engineer, Kansas City Southern Ry. Committee reports dealt with the winter placing of concrete, maintenance of water stations, reducing accidents among employees, smokejacks for roundhouses and the inspection of painting on bridges and buildings.

Subjects selected for the 1925 meeting are as follows: (1) Motor cars for bridge and building gangs; (2) merits of steel and wood sash; (3) creosoted timber with reference to fire hazard; (4) precast concrete units in bridge work; (5) applying protective coatings to structural steel; (6) electric operation for pumping stations; (7) comparison of roofing materials; (8) reduction of accidents to employees; and (9) economical methods for minor jobs of maintenance.

J. P. Wood, supervisor of bridge and buildings, Pere Marquette R.R., Saginaw Mich., was elected president, and C. A. Lichty, Chicago & Northwestern Ry., Chicago, secretary. The next meeting will be held at Buffalo, N. Y., in 1925.

Four Lieutenancies Open in Navy Corps of Civil Engineers

Applications by letter are being received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., to fill four vacancies in the commissioned grade of assistant civil engineer, Corps of Civil Engineers, U. S. Navy, with rank of lieutenant (junior grade), equivalent to first lieutenant in the Army and Marine Corps. The pay and allowances at entrance are approximately $3,200 per annum, with subsequent usual increases upon promotion in rank and with increased length of service.

Candidates must be American citizens between the ages of 22 and 30 years on Jan. 2, 1925. Each must have received a degree in engineering, and must have had not less than 18 months practical professional experience after graduation.

The inspection of information to determine general fitness and making selections to take the final examination will be based on papers, submitted by the candidates, reaching the board on or before Jan. 1, 1925, covering college record, testimonials, references, and professional experience. Candidates will not be required to report in person for the preliminary examination.

Those who qualify in the preliminary examination and who are selected will take the physical and final oral and written examinations, which will probably be held in New York, Washington, D. C., Chicago, and San Francisco, depending on the number of applications from each locality, as soon as possible after the preliminary examination papers have been passed upon by the Board.

Mead's Attitude on Proposed Six New Reclamation Projects

Washington Correspondence

A high value is attached by Dr. Elwood Mead, the Commissioner of Reclamation, to the expressions of the local bankers and business men in connection with the economic surveys made of the six proposed new reclamation projects now under consideration. While it is recognized that local interests will be influenced by the immediate benefits which the development would bring to their section, nevertheless their practical knowledge of such matters as the cost of developing and equipping farms, the acreage value of crops, the amount of credit which the settler would require and the amount of construction cost that would be feasible, make the local comment and criticism of great value. There also is the important benefit, Dr. Mead points out, of allowing substantial men in the locality to share the responsibility if the project is approved by Congress. Moreover, the local interests realize that they will suffer, in the long run, if the projects are not sound financially.

The six proposed new projects are the Vale and Baker projects in Oregon, the Kittitas in Washington, the Owyhee in Oregon-Idaho, the Salt Lake Basin in Utah and the Spanish Springs in Nevada.

Advocate Government Loans to Reclamation Settlers

Washington Correspondence

When the government leases water power or grants almost any other right other than authority to operate a farm on one of its reclamation projects, it makes sure first that the applicant has the financial support necessary to make a success of the project. During the past week the need for such a precaution in the selection of settlers for reclamation projects has been expressed by two men who are thoroughly conversant with the problems of reclamation. L. C. Gilman, vice-president of the Great Northern Ry., says that "the most serious problem for the future of the irrigation districts is the lack of settlers with adequate capital. It may be that the government will have to consider furnishing the settlers with more than the bare land and the water. Many settlers will fail not because of lack of industry or enterprise but simply because their capital is insufficient."

T. J. Larson, the secretary of the Malta irrigation district, who holds similar opinions, cites the unsatisfactory experience in his own district with efforts to deal with settlers who are insufficiently financed. Local business men raised a fund to bring in a number of families. Transportation expenses were paid and accounts opened with them at the stores. It was found this fall that most of these families were not able to meet the notes which had become due at the banks. It is true that certain of the families made good and were in a position to curtail their obligations to a satisfactory extent. He is convinced, however, that the banks and merchants will not continue to finance settlers in this way. Another problem is presented in housing the new settlers. An effort is being made to finance locally the construction of inexpensive houses. In fact, improved farms for 30 families have been made available, but the financing of additional houses on other tracts has not been worked out.

Corrosion Symposium to Feature Chemical Society Meeting

At the Baltimore meeting of the American Chemical Society which will be held during Easter week, 1925, the division of industrial and engineering chemistry will hold a symposium on corrosion. The tentative outline of the symposium is as follows:

1. Submerged corrosion of metals
   a. Iron and steel
   b. Non-ferrous metals
2. Atmospheric corrosion
3. Corrosion of special alloys

It is hoped that the scope of these papers will cover the problems of corrosion in the heavy chemical industry, in the special chemical industry, in the marine world, in ordnance equipment, in the oil industry, in the mining industry, etc. Papers relating to any of these subjects or subdivisions will be welcomed by the chairman of the symposium, who is Robert J. McKay.

Piles of Flooring on Walk Wreck Viaduct

Sidewalk and Girders on Part of Ohio River Bridge at Wheeling, W. Va., Torn Away

A partial collapse of a portion of the Steel Bridge over the Ohio River at Wheeling, W. Va., occurred during the morning of Oct. 15. The collapse was in the viaduct section of the bridge where it crosses the Island, a section consisting of one 50-ft., one 16-ft., and six 28-ft. girder spans. The viaduct carries two trolley tracks, a 16-ft. roadway and has sidewalks on both sides.

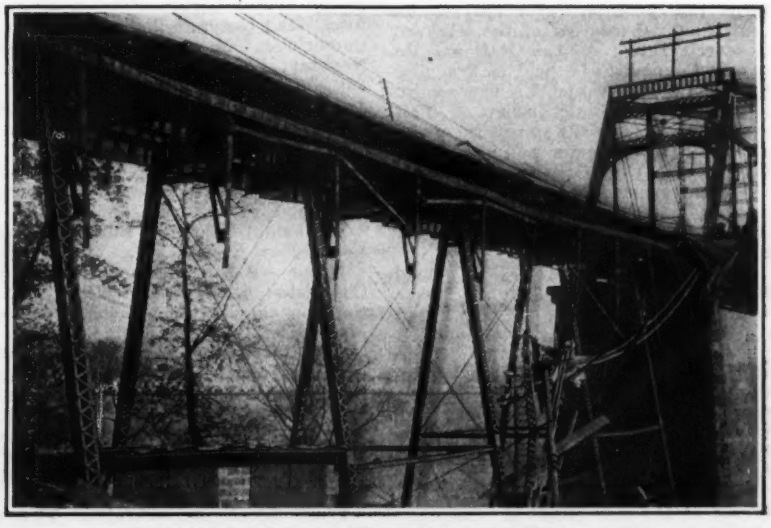
The immediate cause of the collapse was the overloading of the sidewalk with lumber used in reflooring the bridge. When failure occurred the girders at the south side of the viaduct tore away from their connections to the floorbeams for the entire length of the viaduct and remained suspended in a sagging horizontal position between the towers, with the sidewalk brackets hanging from them. The collapse began near the east end and stopped at the west end where the viaduct joins the river span of the bridge. The floorbeams did not go down when the girders fell, but remained about in place, evidently supported by the girder rails of the trolley tracks and the flooring. Only the railing and one bracket fell to the ground. One workman was carried down with the wreckage and killed.

The floorbeams and sidewalk brackets were not continuous in the viaduct section of the bridge. Instead both were secured by a connection of the web between stiffeners on the main girder, without connections to the flanges. Failure stopped at the end of the main span over the Ohio River where this arrangement of the floor system is replaced by one in which the floorbeams and sidewalk brackets are continuous.

The web of the girders is of wrought iron $\frac{7}{16}$ in. thick and shows bad rusting between stiffeners, also incipient cracks which evidently contributed to the failure. The conditions were such that the rusting and cracks were not easily observed.

The bridge is owned and operated by the West Penn Co., owners of the street railway. It was built in 1890 by the Youngstown Bridge Co.

Temporary repairs have been made to the bridge by constructing timber bents to support the floor system until permanent repairs can be made. The permanent repairs are being made by the J. E. Moss Iron Works of Wheeling under the direction of Robinson & Steinman, consulting engineers, New York, who have been retained to investigate the accident and to report on the condition of this bridge and other bridges of the West Penn Co.



PARTIAL COLLAPSE OF BRIDGE AT WHEELING, W. VA.
South girders with sidewalk brackets hang in an overturned position just below the edge of the roadway.

Flood Control on the Mississippi Gets Large Appropriation

Apparently interests along the lower Mississippi River were able at an extended hearing before the Director of the Budget to justify the appropriation of the entire $10,000,000 authorized for flood-control work during the next fiscal year. Colonel Potter, the president of the Mississippi River Commission, emphasized at the hearing that the appropriation of the full amount makes possible a saving of 25 per cent in the cost of levee construction, since it allows contracts to extend over a period of eighteen months.

The Mississippi River Commission has begun the extension of the levee line from Point Breeze to Old River in Louisiana. When completed this levee will close a 7-mile gap. Colonel Potter also states that the commission is about ready to begin the leveeing of the tributaries of the Mississippi insofar as they are affected by the flood waters of that river. As this means a further reduction of reservoir capacity for flood waters, it has had the effect of renewing the demand in New Orleans for a spillway in that region.

Forest Products Utilization Conference Called

There is to be held, Nov. 19 and 20, in Washington, a conference on the utilization of forest products. It has been called by the Secretary of Agriculture because of the pressing problem of maintaining a perpetual supply of forest products sufficient to meet the world's needs, because there is insistent need for more progressive reforestation, because the diminution in forest resources must have a radical effect on wood-using practices, manufacturing enterprises, and living conditions, because two-thirds of the present forest cut is now lost in processes of conversion and through inefficient use, and because better utilization demands the joint efforts of federal, state, and private interests.

Besides being a conference for the determination of better utilization of wood products, it will be somewhat in the nature of a commemoration of the services of the late Secretary of Agriculture, Henry C. Wallace, whose zeal in behalf of forest conservation led to the initial program.

It is expected that a nationally representative advisory committee to assist the Secretary of Agriculture in formulating and carrying out adequate measures to insure efficient development and use of timber resources will be formed. Speakers will include in their discussions comprehensive ideas of the nature and extent of present preventable wastes, how research shows prevention to be feasible, and how better utilization is retarded by failure to apply available knowledge.

The Secretary of Agriculture has asked all associations and organized interests concerned to select delegates to represent them at the conference.

Highway Research Board Program Is Announced

Report on the developments of highway research during the past year will form the principal program at the fourth annual meeting of the Highway Research Board of the National Research Council, to be held in Washington, D. C., Dec. 4 and 5. The reports include (1) economic theory of highway improvement, (2) structural design of roads, (3) character and use of road materials, (4) highway traffic analysis, (5) highway bridges, (6) highway finance, (7) highway maintenance, (8) special investigation of reinforcement in concrete roadway.

In addition, Thomas H. MacDonald, chief of the Bureau of Public Roads, will deliver an address on "The Financial Value of Highway Research as Applied to Road Construction." There will also be papers and discussions on the practical application of various research activities as they affect high ways. Research developments will be illustrated by moving pictures and lantern slides.

At noon on Dec. 4 luncheon will be served at the new building. Secretary of Commerce Hoover will make an address at the highway research dinner to be held on the evening of Dec. 4.

Wisconsin Society to Work for Registration Law

The Engineering Society of Wisconsin proposes to work actively for the passage by the next legislature of a bill for the registration of engineers. Such a bill submitted two years ago was defeated but it is hoped to make it acceptable by cutting out certain features that were objected to and perhaps by eliminating surveyors and state engineers from the provisions of the bill.

A circular from W. G. Kirchoffer, president of the society, states that there is present need of such a law, since several water-supply development companies are seeking work on a "guarantee" basis, without preparing plans and submitting plans to the State Board of Health only after the work is done. They are said to be contractors doing engineering work.

Reserve Corps Promotions and Appointments

Announcement is made by the War Department of the following appointments and promotions in the Engineer Officers' Reserve Corps from Oct. 1 to 18:

Appointments

Major—H. H. Hamilton, New Orleans, La.; Edward Henry Moeller, Buffalo, N. Y.

Captain — Ernest Benjamin Bail, Albuquerque, N. M.; Charles Trueman Bishop, Cleveland, Ohio; Nathan Harris, Newark, N. J.

First Lieutenant—Byron L. Keim, Wilkinsburg, Pa., James Maynard Magruder, Washington, D. C.; Frederick Adolph Platte, New York, N. Y.; Lester David Sandy, East Orange, N.J.; Louis Harrington Zepfler, Roselle, N. J.

Second Lieutenants — Charles Elvin Bickham, Starhill, La.; Sidney William Binckley, Escondido, Calif.; George Wesley Crout, Hazelhurst, Mississippi; Louis Walker Goodrich, Fort Madison, Iowa; Arthur Clayborn Hays, Wauwatosa, Wis.; Gardner Blake MacPherson, Cambridge, Mass.; John Lawrence Novotny, Los Angeles, Calif.; Theron Wright Ragdale, Vicksburgh, Miss.; James Singer, Los Angeles, Calif.; John Summie Whitener, Hickory, N. C.

Promotions

Colonel — Ralph Evelyn Cameron, Urbana, Ill.

Lieutenant-Colonel — Burnside Rene Value, New York, N. Y.

Major — Albert Edward Hutchinson, Charleston, S. C.; George William Martin, Connellsville, Pa.; Jacob Frederick Mollenkopf, Van Wert, Ohio.

Captain—Edgar Llewellyn Barrows, El Paso, Texas; Raymond Colton, South Charleston, W. Va.; Max William Friend, Fort Smith, Ark.; Roy Clayton Gregory, Grove City, Pa.; Hugh Ambrose Kelly, Jersey City, N. J.; John Russell King, Seattle, Wash.; Harry Julius Lemp, Warwick, Mass.

First Lieutenant — Walter Thomas Biggar, Cambridge, Mass.; Clarence Mitchell Burton, Eureka, Utah; William Eugene Byrne, Long Beach, Calif.

Random Lines

The Craze for Organization

Long ago we listed the "Business Engineer" though none of his ilk has so far seen fit to answer our challenge to tell us just what kind of engineering he is supposed to do. The breed multiplies, we note, for a letterhead reading about as follows has just been received:

Institute of Business Engineers, Inc.

FOUNDED 1872 BY

JAMES H. LANSLEY, PH.D.

BUSINESS ENGINEERS CLUBS

POST OFFICE BOX 61

HARVARD SQUARE CAMBRIDGE MASSACHUSETTS

This Mechanized World

The general scheme of reconstruction consists in replacing by osculators of the latest type the four lifts that have hitherto provided connection with the platforms.—From a press notice of improvements at the Trafalgar subway station in London.

Pity the Poor Engineer

While we deplore as much as the next one the scandalous publicity of private affairs made possible in the income tax revelations, we did happen to notice, quite inadvertently in looking for something else on the same page, that a certain extremely well known engineer who retired from the army, after completing one of our country's monumental works, paid a tax for 1923 of $45,093.81. Republics may be ungrateful, as some old Roman said, but sometimes they provide opportunity which can be capitalized beyond much gold.

How to Scare the Prospective Speaker

"It has been the practice in recent years to urge our leading speakers to talk from notes rather than read from a paper. Unless one is a trained elocutionist the reading of a paper is often a monotonous proceeding. Such is not the case when a person speaks extemporaneously. The audience pays much closer attention to the speaker when he talks *to* them than when he talks *at* them, and most public officials are better talkers than readers."—Announcement by the League of California Municipalities.

This is true enough talk, but as Ruggles of Red Gap might have said, "It would never do with us." To read every last preposition seems to be the ambition of every engineer who has a paper to present. A little of the gospel of speaking rather than reading would help the average engineering society.

Railway in Texas Authorized

Construction of 31 miles of railway between Santa Maria and Sammons, in Hidalgo County, Tex., has been authorized by the Interstate Commerce Commission. This railway is to be built by the San Benito & Rio Grande Valley Ry. Co. to connect the two segments of the line it already owns. Funds for the construction, estimated at about $500,000, are to be advanced by the New Orleans, Texas & Mexico Ry. Construction must be begun on or before Jan. 1, 1925, and completed by the end of the year.

A. G. C. Nominations Made

Nominations completing the list of names which will be placed before members of the Associated General Contractors of America on the official ballot to fill 1925 vacancies in the organization were acted upon during the course of the recent sessions at Des Moines. The official ballot will be circulated throughout the membership on or before Dec. 1.

George B. Walbridge, of the Walbridge-Aldinger Co., Detroit, Mich., was nominated to succeed Frederick L. Cranford as the president of the A. G. C. Harry W. Baum, of the H. W. Baum Co., Salt Lake City, Utah, was nominated to hold office as vice-president-at-large during 1925.

Other names to appear on the official ballot follow:

Vice-President, Zone 3—W. F. Creighton, Nashville, Tenn.; Sumner Sollitt, Chicago, Ill.

Vice-President, Zone 5—C. S. Downey, Seattle, Wash.; Godfrey Edwards, Los Angeles, Calif.

Director, District 4—Lea Hunt, Wilkes-Barre, Pa.; E. R. Shenk, Erie, Pa.

Director, District 5—H. R. Blagg, Dayton, Ohio; J. Lee Davis, Richmond, Va.; C. W. Lundorff, Cleveland, Ohio.

Director, District 6—E. C. Derby, Fayetteville, N. C.; F. N. Garthwait, Charlotte, N. C.; J. W. Stout, Sanford, N. C.

Director, District 9—J. S. Crinkley, Memphis, Tenn.; J. Keller, Louisville, Ky.

Director, District 11—Leonard Stark, Cedar Rapids, Ia.; H. S. Tullock, Leavenworth, Kansas.

Civil Service Examinations

UNITED STATES

For the following civil service examinations apply to the U. S. Civil Service Commission, Washington, D. C., or to any local office of the commission.

Junior Cartographic Engineer — Vacancies in the U. S. Coast and Geodetic Survey, at Washington, D. C., and in positions requiring similar qualifications; salary $1,860 a year and possible advancement to $2,400; requirements for examination, 3½ years of civil engineering education but graduation will be required before appointment, and topographic drawing training.

An open competitive examination will be given on Dec. 3.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, San Francisco, Calif., Nov. 17-20, 1924.

ADVISORY BOARD ON HIGHWAY RESEARCH, Washington, D. C.; Annual Meeting, Washington, Dec. 4, 5.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-14, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 21-23.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The New York Building Congress will meet at luncheon at the Hotel Biltmore, Nov. 12. E. J. Mehren, vice-president of the McGraw-Hill Co., Inc., will be the principal speaker; his subject will be, "For a Rebirth of Craftsmanship."

Personal Notes

R. A. SMALL, who recently resigned as engineer for the Industrial Commission of Wisconsin, has established an advisory engineering practice to assist engineers and architects in complying with the requirements of the state building code.

J. O. MARSH has been appointed chief engineer of the Los Angeles Board of Public Utilities, succeeding FRED A. LORENTZ, resigned. Mr. Marsh has been office engineer of the California State Highway Commission at division headquarters in Los Angeles for the past seven years.

J. H. KIMBALL, who was formerly assistant chief engineer of the Miami Conservancy District, Dayton, Ohio has become consulting engineer to the city of Cumberland, Md., for service in flood-prevention work.

H. H. SHERWIN, until recently vice-president and general manager of Terry & Tench Co., has entered independent practice as president and general manager of H. H. Sherwin & Co., Inc., engineers and contractors, with office in Grand Central Terminal, New York. During Mr. Sherwin's ten years of connection with Terry & Tench he was in charge of a large number of important construction enterprises, including the third-tracking of the Broadway elevated railway in Brooklyn, construction of six municipal steamship piers in Staten Island, and erection of the Kingston and Peekskill suspension bridges.

N. ALTIERY, until recently with the Missouri State Highway Department as office engineer in Kansas City, and previously with the Berthe Engineering Co., has returned to locate in Philadelphia, Pa., on account of family illness.

RALPH STRAIT, former county surveyor of Muskingum County, Ohio, and recently engineer in charge of the construction of the Ohio River road in eastern Ohio, has resigned this position with the State Highway Department to accept a place with the Bellaire Land & Development Co. Mr. Strait will supervise the laying out and grading of a large sub-division near Bellaire, and the construction of necessary roads and sewers.

HENRY E. WARMBOLD, recently engineering manager with the General Construction & Repair Co., Cambridge, Mass., who has had varied engineering experience with many large Boston and New York firms, has joined the Boston office force of Stone & Webster, Inc., as engineer in the structural division.

Obituary

A. W. KEDDIE, credited with having made the original survey up the North Fork of the Feather River later adopted by the Western Pacific R.R. as a route over the mountains from Oroville, Calif., to the East, died at Quincy, Calif., Oct. 22, aged 82 years.

H. K. G. BAMBER, of London, England, member of the board of managing directors of both the Associated Portland Cement Manufacturers, Ltd., and the British Portland Cement Manufacturers, Ltd., was instantly killed in a motor-car collision near Gravesend, Sept. 20. Mr. Bamber was educated at University College in London and at the College of Mines in Kensington. He began his work on cement in his father's laboratory and in 1887 became chemist at a large cement works; later he entered the service of the manufacturers of the "Pyramid" cement. In his service as a managing director of the two groups of cement manufacturers Mr. Bamber was responsible in great degree for the improvement in British cement and in the development of concrete construction. He was one of the founders of the British Concrete Institute in 1908. later known as the Institution of Structural Engineers, and was its vice-president in 1924. He was a member of the subcommittee of the British Engineering Standards Association which drafted specifications for portland cement; he also was chairman of the first International Cement Congress held in London last spring.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Seek Reduction in Manhole Varieties

Producing and Consuming Interests Confer at Washington—Recommend Study by Standards Committee

Washington Correspondence

FULL discussion of proposals looking toward standardization and simplification of manhole frames and covers for street use was had at a preliminary conference of interests concerned held with the Division of Simplified Practice of the Department of Commerce Oct. 29 in Washington. While there was general agreement that the movement possessed merit, so many engineering problems were presented as essential to any program of standardization that it was decided first to refer the matter to the American Engineering Standards Committee with a request that a study be made of the technical questions involved and that a report be made on the best practice. After this has been done, it is felt that the question of simplifying sizes and designs in accordance with the best engineering practice will be easy.

Range of Varieties Great

The conference at Washington was called by the Division of Simplified Practice at the suggestion of the Industrial Association of San Francisco, after it had been determined by correspondence that there is strong sentiment among both producers and users of manhole frames and covers for standardization. R. M. Hudson, chief of the Division, presided.

The extremes in the situation, as developed at the preliminary conference, ranged from the statement that the American Telephone & Telegraph Co. has in use throughout the country two styles of frames and covers for manholes, using two sizes of one style and three of the other, to the statement of one manufacturer that his company has in its pattern room, 2,000 different patterns, sizes and designs, for manhole frames and covers.

The major groups of uses considered were: Electric light and power companies, electric street railway companies; telephone and telegraph companies; gas companies; city sewer and city water departments; and coal holes.

Objects Sought

Among technical problems to be considered in standard designs there were suggested: Safety, so that the covers will not slip off; convenience of repair and replacement from traffic wear; greater strength owing to the increasing traffic loads from heavy trucks using the streets; noise and anti-rattle devices; general reduction of cost; adjustability to the wearing down of street pavements to avoid bumps at the covers; sightliness; ventilation, to care

(*Concluded from first column*)

for accumulating gases and for the safety of men working in conduits or pits; protection against ingress of water, particularly for those manholes used by telephone and electric companies, and from ingress of lighted cigars and cigarettes, in the case of gas companies; locking devices to prevent the manhole covers from being lifted and the holes being used for refuse.

Attendance at Conference

Attending the meeting were: W. B. Beale and R. W. Prince, Chesapeake & Potomac Telephone Co., Washington; A. G. Dunn and J. B. Gordon, engineering department, District of Columbia; C. S. Embrey, Associated General Contractors of America, Washington; L. B. Fish, American Telephone & Telegraph Co., New York; P. E. Holden, Chamber of Commerce of the United States, Washington; D. W. Holton, water department, District of Columbia; L. J. Lemert, U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J.; C. L. Lincoln, S. E. T. Valve & Hydrant Co., and representing the Water Works Manufacturers' Association, New York; Alexander Maxwell, National Electric Light Association, New York; Robert E. Moore, Flockhart Foundry Co., Newark.

Also, Robert B. Morse, Washington Suburban Sanitary District, also representing the American Society of Civil Engineers, Hyattsville, Md.; Duncan B. Ransdell, Washington Gas Light Co., also representing the American Gas Association, Washington; F. J. Schlink, American Engineering Standards Committee, New York; Francis Shanley, sewer department, Chicago; V. Bernard Siems, American Water Works Association, Baltimore; and R. M. Hudson, E. W. Ely and A. B. Galt, of the Division of Simplified Practice.

Face Brick and Vitrified Brick or Block for Paving

The Department of Commerce announces that, according to the data collected at the biennial census of manufacturers, 1923, the establishments in the clay-products industry engaged in the production of face brick and vitrified brick or block for paving reported the manufacture of face brick valued at $37,637,972, as compared with $28,233,689 in 1922 and $18,128,217 in 1921, an increase of 33.3 per cent over 1922 and 107.6 per cent over 1921. The total value of vitrified brick or block for paving was $11,359,640, as compared with $9,520,594 in 1922 and $11,201,409 in 1921, an increase of 19.3 per cent over 1922 and 1.4 per cent over 1921.

Face Brick	1923	1922	1921
Number of establishments	391	318	281
Production:			
Quantity (thousands)	1,988,526	1,416,878	873,346
Value, total	$37,637,972	$28,233,689	$18,128,217
Average value per thousand	$18.83	$19.93	$20.76
Per cent of increase:	1922-23	1921-23	
Quantity	40.3	127.7	
Value	33.3	107.6	

Vitrified Brick or Block for Paving	1923	1922	1921
Number of establishments	78	81	90
Production:			
Quantity (thousands)	467,485	440,388	468,945
Value, total	$11,359,640	$9,520,594	$11,201,409
Average value per thousand	$24.30	$21.62	$23.89
Per cent of increase (+) or decrease (—):	1922-23	1921-23	
Quantity	+6.2	—0.3	
Value	+19.3	+1.4	

The statistics for 1923, 1922, and 1921 are summarized in the accompanying table. The figure for 1923 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

Of the 391 establishments reporting the production of face brick, 80 were located in Pennsylvania, 57 in Ohio, 31 in Illinois, 23 in Iowa, 21 in Indiana, 14 in Colorado, and 12 each in California and Oklahoma, and the remaining 141 were distributed throughout 35 states.

Of the 78 establishments reporting the production of vitrified brick or block for paving, 17 were located in Ohio, 12 in Illinois, 9 in Missouri, 7 in Kansas, and 6 in Pennsylvania, and the remaining 27 were distributed throughout 16 states.

Business Notes

Northwest Engineering Co., Chicago, manufacturer of power shovels, cranes and draglines, has opened a branch office at 23 Main St., San Francisco, in charge of W. W. Mutter. The Collins-Kay Co. will handle Northwest equipment in Los Angeles. The Pittsburgh, Pa., territory will be covered by the Beckwith Machinery Co.

Maxwell Spiro & Co., dealers in iron, steel and structural machinery, have recently moved from 30 Church St., New York, to the foot of Grove St., Jersey City. The new plant includes a yard 260 x 200 ft. with two private sidings to the Lehigh Valley R.R., accommodating fifteen cars.

Chicago Bridge & Iron Works has received an order from the Electric Bond & Share Co. for furnishing and erecting at Miami, Fla., a 1,000,000-

cu.ft. gas holder involving approximately 1,000 tons of plate work. The contract makes the unusual provision that the bottom of the tank and the roof of the holder are to be welded and in addition provides that an oil storage tank of 240,000 gal. capacity shall be placed inside of the holder.

BEAVER MANUFACTURING CO., Milwaukee, Wis., builder of industrial gasoline engines, has acquired 20,000 additional square feet of floor space, all of which is occupied by the assembling and testing department. The company reports an increase of 69 per cent in this year's business as compared with last year.

WILLIAM C. BATCHELDER, North Haverhill, N. H., formerly distributor-salesman for Bear Tractors, Inc., in the states of Maine, New Hampshire and Vermont, has discontinued that connection to become the New England representative of the J. T. Tractor Co., Cleveland. As accessories for its tractor the company can supply snow plows and other equipment.

JOHN F. REGAN, Jr., president, Water Works Manufacturers Association, and Eastern sales manager, Neptune Meter Co., died Nov. 1st in Utica, N. Y., his native city, where he had been taken from New York Oct. 24. Before joining the Neptune organization in 1910 Mr. Regan had been general manager of the Consolidated Water Co. at Utica.

Equipment and Materials

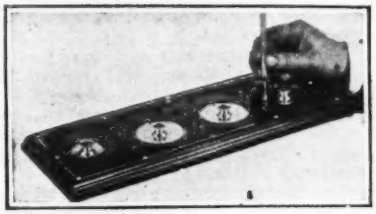
Trench Excavator Equipped with Boom Stabilizer

To insure digging to grade in hard dry clay or other difficult soil the Buckeye Traction Ditcher Co., Findlay, Ohio, has developed for its chain and bucket type of trench excavator a boom stabilizer; a secondary function of the device is to reduce vibration.

As shown in the accompanying illustration two small pinion gears, one at each side of the boom, mesh with rack gears mounted on the A-frame. The pinion gears are mounted on a floating shaft set in bearings fastened to the boom. At the center, inside the box girder boom, a large steel wheel fitted with brake bands is keyed to this shaft. The boom is set at the desired depth and locked in place by tightening the brake on the wheel. The brake is controlled from the operator's platform by a lever and cable. The location of the brake wheel inside the box girder boom excludes dirt and assures a long life for the brake lining. Patents are pending on the stabilizer device.

Machine Adds Whole Numbers, Feet, Inches and Fractions

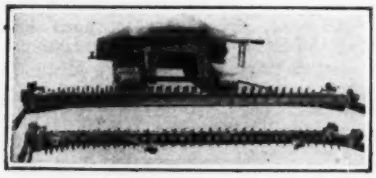
For adding whole numbers or dimensions in feet, inches and fractions, the Precision Adding Machine Co., New York, has introduced the Quixsum adding machine, which, it is claimed, can be put to a number of uses by engineers, architects and contractors. The device, which weighs 3½ lb. and has dimensions of 15 x 4½ x 1 in., is equipped with four dials, the first for whole numbers, the second for feet, the third for inches and the fourth for fractions of 1/32.



The machine is operated by inserting a stylus in perforations in the dial and turning clockwise. The results of the addition are shown by numbers appearing in slots at the left of each dial.

New Road Subgrade Planer Attached to Paving Mixer

Attached by a pair of drawbars to the crawler frame of a paving mixer, a new road subgrade planer, consisting of a double row of scarifying teeth mounted 1 ft. in front of a blade scraper, has just been placed on the market by the Koehring Co., Milwaukee. As the mixer moves forward, the planer is drawn along behind it on the road forms by a pair of small flanged wheels at each end, as shown in the accompanying photograph. The machine may be attached either behind the mixer, under the discharge chute, or in front, directly back of the charging skip; the best results, according to the manufacturer, are obtained with the device in the position first named.

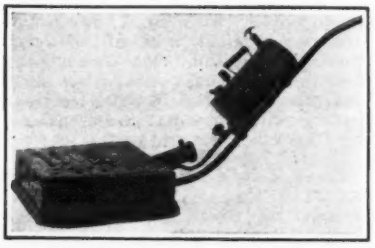


The machine is adjustable to different types of road crowns and is built for widths of 16, 18 or 20 ft. The 18-ft. machine weighs 1,410 lb. In operation the scarifying teeth are set a little below the lower edge of the scraper blade so that they cut down high spots and leave the surface in a condition to be smoothed off by the scraper. In light soil the planer grades to a depth of 2 in., but is not designed to work in hard clay or old macadam. When the mixer is ready to move ahead the spreading crew mount the planer to give added weight; where the soil is hard the grading operation can be repeated by backing up the mixer and going over the ground a second time.

Squeegee Machine for Block or Bituminous Floors

Forced bleeding of tarred or creosoted block floors or ironing out of bituminous floors is the purpose for which a new device has been produced by the Chausse Oil Burner Co., Elkhart, Ind. This machine, as illustrated, is a large flat iron or squeegee equipped with a kerosene burning torch. While it was designed primarily for repair work in softening floors and pavements it can also be used on new work where any warming effect is desired. It has been employed for warming concrete floors which are to be covered by wax or rosin before painting, insuring the binding of the wax to the concrete so that the paint does not peel.

The heat is so distributed over the floor or pavement that it does not burn blocks or asphalt and will only brown paper. This machine brings tar to the surface so that it may be scraped off and warms asphalt so that it can be rolled or tamped. It is not intended for street repairing now done by surface heaters. The torch furnished is a standard 3-gal. Chausse kerosene torch which may be detached for other uses and has sufficient fuel for 3 hours' continuous operation.



English Electric Power Shovel Has 10-Yd. Dipper

An electric power shovel with a dipper capacity of from 10 to 12 cu.yd. has recently been built by the English firm of Ruston & Hornsby, Ltd., for use in excavating brown coal by the State Electricity Commission of Victoria, Australia. The machine, according to *Engineering*, is capable of making a cut 75 ft. deep and 60 ft. wide; the digging capacity is given as 3,000 tons in 8 hr. The boom has sufficient reach to load cars 100 ft. from the axis of rotation and at a height of 70 ft. above the working level.

Separate motors are provided for the crowding, swinging and hoisting operations, also for opening the door in the bottom of the dipper. Direct current at 440 volts is used. The machine weighs about 350 tons and is mounted on four-wheel trucks, one set at each corner of the main frame. A complete cycle of operations for the shovel takes about one minute. Two men are required to operate the machine, one con-

trolling the movements and the other attending to lubrication and miscellaneous details.

Publications from the Construction Industry

Roof Tile Machine—CONCRETE TILE MACHINERY CO., Cicero, Ill., has issued a 16-p. illustrated pamphlet on the Hawthorne automatic machine for the production of concrete roofing tile.

Concrete Placing Equipment—LAKEWOOD ENGINEERING CO., Cleveland, presents, in a 68-p. illustrated booklet, an unusually complete discussion of methods and equipment for the placing of concrete by chuting. The three standard types of chuting plant are: (1) The boom plant; (2) the unit plant; and (3) the continuous line plant. Boom and unit plants apply almost entirely to building work and continuous line plants to dams, bridges and work of a similar character. The text contains practical hints on the proper consistency of concrete, slope of chute line and size of bucket. Chutes are now built to handle concrete carrying aggregate up to 6 or 8 in. in size. Photographs, with brief descriptions, illustrate typical uses of the equipment. In addition, there are blueprint drawings showing installation details and plant layouts. The publication is replete with information of practical use to contractors and engineers.

Sheet Metal Guide—MILWAUKEE CORRUGATING CO., Milwaukee, Wis., has issued two 64-p. illustrated booklets on its Milcor architectural sheet metal building products, including tile and shingles, roof trimmings, ventilators, cornices, ceilings and gutters. The roofing tile are furnished in a variety of styles and colors. The company's Milcor Manual is a data book containing tables, specifications and general information on Stay-Rib and Netmesh standard metal lath, steel domes, and other fireproof building products.

Power Drag Scrapers—SAUERMAN BROS., Chicago, feature their power drag scrapers in a 32-p. illustrated pamphlet. The text covers briefly the several types and sizes of scraper bucket and the power requirements for operating them, including steam, gasoline and electricity. Tables showing handling capacities for different sizes of scraper and different lengths of haul indicate the amount of work that can be done. The concluding portion of the pamphlet is devoted to illustrated descriptions of typical installations, including the loading of cars and trucks, operations at gravel pits, cuts and fills, stripping of overburden, and storing and reclaiming loose materials.

Asphalt and Tar Heaters—UNION IRON WORKS, Hoboken, N. J., is distributing a 22-p. illustrated pamphlet on tar and asphalt portable heaters, ranging in capacity from 20 to 700 gal. The text also describes an asphalt and sand mixer for producing mastic filler for granite block paving.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Duquesne Power Plant To Cost About Thirty Million

The first development on the new power station project for the Duquesne Light Co. at Shippingport, Pa., is scheduled to start sometime during the coming year.

The site of the new station is located on the Ohio River, just below the borough of Shippingport, Beaver Co., Pa. This station, when in service, will be the third large station on the company's 66,000-volt ring that surrounds industrial Pittsburgh.

The Brunot Island station is located in the heart of the downtown district and the Colfax station lies approximately 16 mi. northeast of the center of the city.

These three large stations will be located at triangular points on the 66,000-volt ring. The new station will be modeled somewhat after Colfax and with an ultimate capacity of about 300,000 kw. The ultimate cost cannot be estimated at this time but will be in the neighborhood of $30,000,000.

This Shippingport project is only in its first stages as no actual construction work will be started this year. The Dusquesne Company has purchased approximately 765 acres of surface land and nearly 2,000 acres of coal, in and about Shippingport.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 249 to 258, are the following:

Apartment, New York, N. Y., Sixty East 65th St. Corp., to D. P. Robinson & Co., Inc., $4,500,000.

Office, New York, N. Y. F. T. Ley & Co. will build by day labor, $3,000,000.

Railroad, Wisconsin Southern Railway Co. to E. Schuster, $2,500,000.

Street work, Minneapolis, Minn., by day labor, $2,400,000.

Water-works, Minneapolis, Minn., by day labor, $1,500,000.

Foreign Projects of Interest to Americans

Further information is available concerning these projects at the Bureau of Foreign and Domestic Commerce or its district co-operative offices, when a reference number is given.

Coal loading plant for Recife, Brazil. Additional information as to the requirements for the construction of the proposed coal gantry at the port of Recife in Pernambuco. Reference No. 145,658.

Road construction to be resumed in Mexico. The state of Chiapas will build a road of 327 kilometers. Reference No. 142,012.

Public works for a city in Ecuador. Bids for the construction of an electric-light plant, pumping station and water-supply system have been called for. Reference No. 142,795.

The Construction Situation

Construction materials in general have decreased 8 per cent in price during the last year. Labor rates, however, have advanced, common labor 4 per cent over the entire country; the principal skilled trades, 7 to 13 per cent. As there are only about half enough skilled building trades mechanics, (particularly bricklayers, plasterers, carpenters and plumbers) to meet the current demand, wage decreases cannot be expected. This situation must continue while membership in the unions is rigidly restricted as at present.

Since Jan. 1, 1924, general construction cost has declined 5 per cent. During the ten months of this year, average cost has been slightly higher than in that period of 1923. Nevertheless, the volume of contracts awarded thus far in 1924 is 5 per cent heavier than in the first ten months of 1923.

At present 1924 has a lead of $80,000,000 over the contract totals reported by *Engineering News-Record* in the first ten months of last year. These figures are for engineering construction contracts: public work $25,000 and up; industrial buildings $40,000; commercial buildings $150,000 and up. It is expected that the total for this year will slightly exceed that of 1923—the record year.

CHIEF INCREASE IN COMMERCIAL BUILDINGS

The increase is general throughout the country, except in the territory immediately west of the Mississippi. Much the heaviest gain is in the Middle Atlantic states; this despite the fact that building in New York City has been slowing steadily since February. Incidentally, commercial building construction in the City amounts to 18 per cent of the country's total. The chief increase this year has been in commercial building; the chief decrease in industrial building.

Guessing aside, some indication of the construction needs of the country may be had by comparing the volume of the last dozen years with what may be regarded as the normal development of the country. Had heavy construction (of the size indicated) gone forward at the 1913 rate, without any increase of the rate from year to year, the eleven-year total would have exceeded $9,000,000,000, allowing for a total increase in cost of 40 per cent over that period. Actually, cost has averaged 66 per cent above 1913, and at this level the 1913 rate would have aggregated nearly $13,000,000,000. Actual construction has been less than $12,000,000,000. In other words the actual gross volume of construction is slightly below what it would have been had the 1913 rate continued.

October Construction Volume Heaviest for That Month Since 1919

Gain of Three per Cent in Money Value of Contracts Let Compared With Preceding Month

The volume of October construction represented the heaviest recorded since the corresponding period in 1919, according to *Engineering News-Record's* Construction Volume Index Number.

The Volume Index for the month of October, each year from 1919 to date, follows: 1924, 174; 1923, 127; 1922, 127; 1921, 109; 1920, 73 and 1919, 224.

The Index Number expresses the actual physical volume of construction based upon 1913 as 100, or the amount of work accomplished with 1924 money on a 1913 price basis.

The total money value of contracts let was $196,387,000 for the entire country, or an average weekly value of $39,277,400 during October, 1924 as against a weekly average of $38,254,750 for September, 1924 and $39,436,500 for October, 1923. The higher volume is due to a 7 per cent reduction in prices of materials compared with a year ago.

Minimum costs observed in the Construction News section of *Engineering News-Record* in each class of construction are as follows: Waterworks, and excavations, $15,000; other public works, $25,000; industrial construction, $40 000 and commercial buildings, $150,000.

October construction was particularly heavy in commercial buildings, Federal Government work and excavations.

Among the large contracts let during October were the following: Office building, New York, N. Y., $6,000,000; hotel, New York, N. Y., $5,500,000; store, Newark, N. J., $5,000,000; office and exchange, St. Louis, Mo., $5,000,000; loft, New York, N. Y., $3,500,000; hotel, Quebec, Can., $3,000,000; athletic club, Philadelphia, Pa., $3,000,000; hotel and club, New York, N. Y., $2,000,000; apartment, Detroit, Mich., $2,000,000; reclamation, Tampa, Fla., $2,000,000; clubhouse, New York, N. Y., $1,650,000; power plant, St. Narcisse, Que., $1,500,000.

Engineering News-Record Construction Cost Index Number

November, 1924	205.70
October, 1924	207.55
November, 1923	220.90
Peak, June, 1920	273.80
1913	100.00

Jan., 1923	191.70	Nov.	220.90
Feb.	197.40	Dec.	217.30
Mar.	205.25	Jan., 1924	217.90
April	213.50	Feb.	220.30
May	216.70	Mar.	224.60
June	220.70	Apr.	221.60
July	222.10	May	222.38
Aug.	221.50	June	216.85
Sept.	221.50	July	214.40
Oct.	220.30	Aug.	213.15
		Sept.	211.25

Engineering News-Record's Construction Cost Index Number declined 1.85 points since last month, owing to lower steel and lumber prices. The average rate for common labor is still 56c. per hr., against 55c. seven months ago and 54c. in November, 1923. Thus general construction cost is 7 per cent lower than one year ago and 25 per cent under the peak; it is 106 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

October, 1924	(*5 issues of E. N.-R.*)	174
September, 1924	(*4 issues of E. N.-R.*)	135
October, 1923	(*4 issues of E. N.-R.*)	127

Entire Year

1923	135
1922	130
1921	88
1920	91
1919	91
1918	80
1917	64
1916	97
1915	95
1914	104
1913	100

Engineering News-Record's Construction Volume Index Number is 174 for the month of October, and 135 for the whole of 1923, as against 100 for 1913. This means that the actual volume of construction in 1923 (not the mere money-value of the contracts let that year) is 35 per cent above the volume of construction for 1913. Our monthly volume number, 174 for October, 1924, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING OCTOBER, 1924

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Western	United States	Canada	Grand Total
Waterworks	$311,000	$796,000	$402,000	$959,000	$432,000	$524,000	$3,424,000	$620,000	$4,044,000
Sewers	170,000	1,583,000	230,000	1,759,000	1,754,000	542,000	6,038,000	332,000	6,370,000
Bridges	78,000	1,674,000	236,000	1,233,000	1,022,000	404,000	4,647,000	186,000	4,833,000
Excavation, Drainage, etc.	47,000	271,000	2,541,000	23,000	1,161,000	492,000	4,535,000	432,000	4,967,000
Streets and Roads	526,000	6,595,000	6,703,000	9,072,000	7,517,000	3,784,000	34,197,000	1,001,000	35,198,000
Industrial Building	1,820,000	1,964,000	905,000	2,890,000	1,943,000	1,522,000	11,044,000	1,700,000	12,744,000
Commercial Building	9,559,000	46,550,000	2,890,000	14,843,000	14,826,000	17,399,000	106,067,000	3,527,000	109,594,000
Federal Government	167,000	1,420,000	441,000	270,000	963,000	469,000	3,730,000		3,730,000
Unclassified	236,000	14,065,000	336,000	1,715,000	2,892,000	3,461,000	22,705,000	2,202,000	24,907,000
October, 1924	$12,914,000	$74,918,000	$14,684,000	$32,764,000	$32,510,000	$28,597,000	$196,387,000	$10,000,000	$206,387,000
September, 1924	20,375,000	34,110,000	13,874,000	35,009,000	13,951,000	17,700,000	153,019,000	8,113,000	161,132,000
August, 1924	15,231,000	25,636,000	15,789,000	40,611,000	34,320,000	26,798,000	158,385,000	4,907,000	163,292,000
Total 3 months	$48,520,000	$134,664,000	$44,347,000	$108,384,000	$98,781,000	$73,095,000	$507,791,000	$23,020,000	$530,811,000

Labor Rates and Conditions Throughout the Country

A four per cent increase in the volume of construction during the past month, over the month preceding, was accompanied by improvement in several of the other basic industries, namely: Iron and steel (production); lumber (demand); textiles; shoes; packing products; coal; drugs and chemicals.

A survey conducted by the U. S. Department of Labor in forty representative cities of the nation reveals the fact that carpenters' wages have advanced 7 per cent; bricklayers', 9 per cent and plasterers', 13 per cent during 1924, over the schedules in effect last year.

The average union wage scale for bricklayers is now 103 per cent above the 1913 level; that of carpenters, 110 per cent and plasterers, 117 per cent.

Possibilities of lower wage rates in the building trades are very remote, considering the present slow rate of increase in the skilled labor supply.

The average wage rate for common, unskilled labor remains at 56c. per hr., at which level it has stood for the past seven months. The average for the nation was 54c. in November, 1923.

Local conditions as reported to *Engineering News-Record* follow:

Baltimore—Conditions normal in the building trades.

Boston — Slight excess of unskilled, non-union laborers.

Chicago — Perceptible decrease in demand for building trades mechanics. No prospects of move for advance in wage schedules at present time.

Cleveland—Bricklayers on strike as a result of dispute with plasterers over mantel installation. Lathers' union voted in favor of 40-hr. week. Measure to pay union scale to city employees defeated.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.75	.90@1.20	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	1.00@1.50	.25@.75	.75@1.00	.35@.45	.....	1.00	.25@.40
Boston	1.25	1.00@1.10	1.25@1.35	.82½	1.05	1.25	—.50@.75
Cincinnati	1.50	1.25	1.25	.92½	1.25	1.25	.55
Chicago	1.50	1.15@1.25	1.10@1.25	1.00	1.25	1.25	.75@.82½
Cleveland	1.50	1.25	1.25	.87½	1.00	1.37½	.87½
Dallas	1.50	1.00	1.00	+.40@1.00	.87½	1.00	+.40@.75
Denver	1.62½	1.12½	1.12½@1.18¾	.81¼@.87½	1.00	1.15⅝	.35@.55
Detroit	1.50	.90@1.00	.85@1.00	.90	.85@1.00	1.12½	.60@.75
Kansas City	+1.37½@1.50	1.25	1.00@1.25	—.87½	+1.00@1.15	+1.00@1.25	+.40@.70
Los Angeles	1.25	.87½	.87½	1.12½	.75	.87½	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	1.00	.65	.62½	.45	.50	.65	—.25@.30
New Orleans	1.25	.90	1.00	.65	.80	1.00	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00@1.12½	1.31¼	.62½@.75
Philadelphia	1.50	1.12½	1.02½	1.12½	1.00	1.12½	.40@.45
Pittsburgh	1.55	1.37½	1.12½@1.37½	1.00	.....	1.37½	.70
St. Louis	1.75	1.50	1.50@1.67½	1.15@1.25	1.25	1.50	.45@1.10
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.25	1.00	1.00@1.12½	1.00	1.00@1.12½	1.12½	.62½

Dallas—Scarcity of hod carriers and common laborers. Slight surplus of other trades.

Detroit—Labor more plentiful owing to slackening of construction work and reduction of forces in industrial plants, particularly automotive.

Kansas City — All trades plentiful. Payment of bonuses still prevalent in some instances, particularly bricklayers and carpenters.

New York—Tile setters and steamfitters are the only trades in which shortage exists at the present time in this city.

Pittsburgh — Building trades plentiful in every line.

St. Louis — Question regarding handling of reinforcing bars, existing between the structural iron workers and common laborers, to be placed before the National Board of Jurisdictional Awards at the next meeting, to be held in St. Louis, Dec. 8, 1924.

San Francisco—Building trades busy. Weather conditions favor continuation of active construction program.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Price trend continues downward with firmness developing in brick, gravel and paint materials. Cement, however, maintains stability.

Pig Iron—Aside from a slight buying activity in Pennsylvania and the Middle West, the pig-iron market is somewhat dull, compared with a month ago. No. 2 f'dry, Southern, is still $18 to $18.50 per ton at Birmingham, unchanged from the October level. One year ago the price was $23 per ton.

Railway Supplies — Heavy car and rail orders are being booked at the steel mills. Spikes, bolts and tie plates are also in good demand. Standard spikes are higher at mills. Slight downward trend is noted, however, in railway ties and light rails.

Pipe—Merchant pipe prices are firm, with no change in basing discounts at mills or warehouses. Sewer pipe has advanced at mills but the change has not yet affected warehouse quotations generally.

Road and Paving Materials — Few fluctuations in road oils and asphalt prices. Firmness, however, is reported in paving stone and wood blocks in Kansas City and Boston. Streets and roads contracts for the entire country during October, were 17 per cent under those of the month preceding in total money value.

Sand, Gravel and Crushed Stone—Gravel firmer in New York, Boston and Kansas City districts. No change in sand in nineteen cities reporting regularly to *Engineering News-Record*. Crushed stone up 10c. per ton in Boston; no other changes.

Lime and Cement—Slight easing in lime prices reported in New York, Boston, San Francisco, Minneapolis and Kansas City. Practically no change in the cement line-up during the past month; present price level below that of a year ago.

Brick and Hollow Tile — Common brick rose $1 per M in New York City during the month. Present level $18, against $17 per M. delivered at site of job. Price trend is downward, however, in Boston and Atlanta. Slight decline in factory base on hollow tile. Minneapolis is the only city out of twenty-one reporting any reflection of the factory change in local dealers' prices.

Structural Steel—Price trend is upward in steel for the first time since March. Strength is centered mainly in sheets, bars, spring steel and tin plates. Railway material and structurals in good demand. Current mill quotations are as follows: reinforcing bars, $2; plates, $1.60@$1.90; shapes, $1.80@$2 per 100 lb., f.o.b., Pittsburgh. Present prices of the principal hot-rolled products are about 10c. per 100 lb. below those of a month ago. Shapes were $2.50 per 100 lb., f.o.b. Pittsburgh, one year ago.

Lumber—Production, shipments and demand are all below a year ago. Mill prices, however, are holding firm with very little tendency toward price cutting. Inquiries are fairly active in ll. pine shed stock, flooring, finish and timbers. Pine advanced during the month in Philadelphia and St. Louis; fir, in Minneapolis, Philadelphia and Detroit; hemlock, in Boston, Philadelphia and Denver and spruce, in Boston. Pine declined, however, in Atlanta and New York and fir, in San Francisco since Oct. 1, 1924.

Linseed Oil—Present quotations are 5c. per gal. above a month ago and 10c. higher than one year ago in New York City. General trend is upward in this and other paint materials.

Red and White Lead—Prices are 1c. per lb. above the Oct. 1 level and 11c. higher than a year ago. Advance is due to higher pig lead prices brought on by increased demand.

Price advances since last month are indicated by heavy type; declines by *italics*

PIG IRON—Per Gross Ton, f.o.b.:

	Nov. 6	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$21.55**	$26.05
Northern Basic	*21.27*	25.00
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	21.77	25.00
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*25.10*	29.00
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	18.00@18.50	23.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	*22.34*	24.25
Virginia No. 2 (silicon 2.25 @ 2.75)	**29.75**	28.17
Basic	**21.25**	25.00
Gray Forge	**21.25**	25.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	**20.50**	25.50
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*24.50*	28.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	22.77	26.77
Basic	22.77	26.77
Bessemer	*23.77*	27.77

SCRAP—The prices following are per gross ton f.o.b. paid to dealers and producers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	$14.00	**$14.00***	**12.00@13.00**
Stove plate	10.00	**14.50***	*13.50@14.00*
No. 1 machinery cast	14.00	**17.50***	14.00@**15.00**
Machine shop turnings	8.00	**9.00**	6.00@7.00
Cast borings	9.00	**11.50**	*7.00@8.00*
Railroad malleable	13.00	**18.00**	*12.00@13.00*
Re-rolling rails	14.00	**17.00**	15.00@16.00
Re-laying rails	22.00	**26.00**	23.00
Heavy melting steel	12.00	16.00	.....

* Per net ton.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Nov. 6	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	$46.00
Standard openhearth rails	43.00	43.00	43.00	43.00	46.00
Light rails, 8 to 10 lb.	*33@35*	43@45	2.00*	*36@38*	2.55*
Light rails, 12 to 14 lb.	*33@35*	43@45	2.00*	*36@38*	2.35*
Light rails, 25 to 45 lb.	*36@39*	43@45	2.00*	*36@38*	2.35*
Rerolled Rails	*27@32.50*	37@39	.....	36.00	2.10*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.45	$1.70
Chicago, (creosoted) (zinc treated)	1.85	2.10
San Francisco, Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Pine, plain	1.20	1.40
St. Louis (creosoted) (zinc treated)	*1.60*	*1.90*
St. Louis, Red Oak, plain	*1.10*	*1.30*
St. Louis, Sap pine and cypress	*.95*	*1.15*
Birmingham, white oak	1.25	1.50

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Nov. 6	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	**$2.70@2.80**	$3.15	*$3.45*	$3.75	$4.35	$3.72
Track bolts	3.75@4.00	4.00@4.25	*4.45*	4.65	5.85	4.57
Standard section angle bars	2.75	2.75	3.40	3.40	4.00	3.20

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1¼	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	23	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black Birmingham	Black St. Louis
1 to 3 in. butt welded	48%	56%	61%	49%
2½ to 6 in. lap welded	44%	53%	58%	46%

	Galvanised New York	Galvanised Chicago	Galvanised Birmingham	Galvanised St. Louis
1 to 3 in. butt welded	34%	43%	50%	36%
2½ to 6 in. lap welded	30%	40%	48%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4%, less 5%; class A, plus 23%. Cast iron, standard sizes, 34@5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	Pittsburgh	New York Nov. 6	New York One Year Ago
4 in.	*$48@49*	$61.60@**63.60**	$61.60@62.60	$68.60
6 in. and over	*44@45*	**56.60@58.60**	56.60@57.60	63.60

	Chicago	St. Louis	San Francisco
4 in.	*$55.20@55.20*	$54.60	$60.00
6 in. and over	*50.20@51.20*	50.60	56.00

Gas pipe and Class "A," $5 per ton extra.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Nov. 6	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00*	$45.00	$55.00	$50.00	.....	$73.00
4	55.00	55.00	55.00	60.00	$76.50	110.00
5	80.00	80.00	.....	90.00	97.75	118.09
6	105.00	105.00	85.00	100.00	127.50	150.00
8	170.00	170.00	195.00	200.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	**$0.099**	$0.105	.....	.....	$0.12	.....
4	.....	**.099**	.10	$0.1175	.....	.15	$0.15
5	.....	**.1485**	.14	.....	.....	.18	.18
6	$0.21	**.1485**	.165	.1645	.....	.21	.21
8	.36	**.231**	.265	.26	.....	.30	.325
10	.53	**.3465**	.385	.364	.....	.42	.476
12	.68	**.4455**	.46	.468†	.....	.54	.612
15	1.14†	**.594**	.655	.78†	.....	.90	1.02
18	1.65†	**.825**	.70	1.092†	.....	1.32	1.53
20	2.00†	**.99**	1.40	.....	.....	.....	.....
22	2.65†	**1.32**	1.68	1.456†	.....	.....	1.564
24	2.97†	**1.485**	1.75	1.872†	.....	2.16	2.04
27	4.65†	**2.665**	2.80	2.75†	.....	3.00	3.34
30	5.16†	**2.952**	.....	3.40†	.....	3.60	4.06
33	6.98†	**3.96**	.....	4.05†	.....	.....	4.99
36	8.00†	**4.51**	.....	4.45†	.....	.....	5.42

	3	5	8	12	24	36
Boston	**$0.135**	$0.215	**$0.35**	**$0.70**	**$2.25†**	**$6.50†**
Minneapolis	.....	.....	.40	.72	2.55†	5.66†
Denver	.135*	.18*	.27	.47	1.78	.....
Seattle	.14	.....	.35	.72†	2.60†	.....
Los Angeles	.1625	.195	.275	.495	1.65	.....
New Orleans	.148*	.207*	.345	.586	1.182	.....
Cincinnati	*.105*	*.1575*	.245	*.4725*	*1.575*	*4.715*
Atlanta	.11*	.135*	.225	.3825	1.4625	.....
Montreal	.68†	.45†	.70	1.35	4.50†	.....
Detroit	.111	.1665	.259	.4995	2.43†	6.15†
Baltimore	.111	**.167**	.259	.499	1.665	4.92
Kansas City, Mo	*.132**	**.32**	**.52**	.....	.....	.....
Philadelphia	.12	.18	.28	.54	1.80	4.61

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Nov. 6	One Year Ago
New York, 45% asphalt	(at terminal)	$0.055	$0.053
New York, 65% asphalt	(at terminal)	.06	.052
New York, binder	(at terminal)	.065	.06
New York, flux	(at terminal)	.04	.06
New York, liquid asphalt	(at terminal)	.06	.048
St. Louis, 40@50% asphalt		.0475	.053
St. Louis, 50@60% asphalt		*.0481*	.055
Chicago, 40–50% asphalt		.....	.0525
Chicago, 60–70% asphalt		.....	.055
Dallas, 45% asphalt		.0495	.0495
Dallas, 55% asphalt		.0455	.0455
Dallas, binder		.061	.061
San Francisco, binder, per ton		11.00*	9.50*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$19@20*	$15@16
Boston (*Mexican*)	21.00	16.00
Chicago (*Stanolind*)	21.00	15.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00	11.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	22.25	20.50
Denver (*California*)	24.00	
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.10	19.10
St. Louis (*Mexican*)	28.50	23.50
Baltimore (*Mexican*)	*18.00*	*14.00*
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	32.00	28.50
Detroit (*Mexican*)	22.00	18.00
Cincinnati (*Kentucky Rock*)		11.65
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	20.50	17.50
Philadelphia (*Mexican*)	*19.00*	16.00
Kansas City (*Texas*)	27.30	22.30
Los Angeles ("*D*" *grade, California*)	18.00	12.00†
Birmingham (*Mexican*)	32.00	28.50

*In drums. †f.o.b. El Segundo Refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$135.00 per M.
Chicago	About 4x8x4 dressed	per sq.yd.
	About 4x8x4 common	per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	132.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4	1.65 per sq.yd.
Kansas City	Granite	3.85 per sq.yd.
Philadelphia	Granite	3.00@4.15 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—In truckload quantities:

New York	Bronx, 4 ft. wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.20 per lin.ft.
Chicago	18 in. wide....No market	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 85c.; 5 x 20 in., Queens, 95c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., 90c. per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq Yd.
New York (*delivered*)	3	16	$2.39
New York (*delivered*)	3½	16	2.67
Boston	3½	18	2.60
Chicago	4	16	
Chicago	3½	16	
St. Louis	3½	16	2.35
St. Louis	4	16	2.65
Seattle	4	16	Off market
Minneapolis	3½	16	2.75
Atlanta	3½	16	*1.00*
New Orleans	3	16	1.70
New Orleans	3½	16	2.10
New Orleans	4	16	2.50
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	
Cincinnati	3½	16	2.38
Kansas City	4	16	4.00
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Nov. 6	Gravel 1½ In. One Year Ago	Gravel ¾ In. Nov. 6	Gravel ¾ In. One Year Ago	Sand Nov. 6	Sand One Year Ago
New York (*alongside dock*)	$2.00	$1.75	$2.00	$1.75	$1.00	$1.25
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago		2.00		2.00		2.00
St. Louis	1.45†	2.30†	1.65†	2.35†	1.18†	2.10†
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	*1.65**	1.85*	*1.65**	1.85*	1.25	1.25
Cincinnati	1.40†	1.35†	1.40†	1.35†	1.35†	1.35†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50†
Boston	1.50†	1.40†	1.50†	1.40†	1.00†	1.10†
New Orleans	3.00	2.85	3.00	2.85	1.25	1.25
Los Angeles	1.50†	2.50†	1.55†	2.50†	1.10†	1.75†
Atlanta	1.90†	1.85†	1.90†	1.85†	1.40†	1.24†
Detroit	2.02	1.62	2.02	1.62	1.62	2.02‡
Baltimore	1.40	1.40	1.60	1.60	0.70†	0.70†
Montreal	1.25†	1.25†	1.25†	1.50†	1.25†	1.25†
Birmingham	2.00	....	2.00	....	1.30†	1.30†
Philadelphia	2.10	2.00†	2.10	2.00†	1.50	1.50
Kansas City	4.00‡	....	4.00‡	....	0.66*†	....

New York—Grits, $1.75 per cu. yd.; ready mixed, *$1.85*.
Los Angeles—Freight from quarry 70c. per ton, and is included in above price.
* At pit. † Per ton. ‡ Joplin chats.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Nov. 6	1½ In. One Year Ago	¾ In. Nov. 6	¾ In. One Year Ago
New York	$1.75	$1.65	$1.85	$1.75
Chicago		2.00		2.00
St. Louis	1.75*	1.75	1.75*	1.90
Dallas	2.40	2.83	2.83	2.83
San Francisco	2.15	2.15	2.15	2.15
Boston	1.60*	1.55*	1.60*	1.55*
Minneapolis	1.75	1.85	1.75	2.00
Kansas City	1.50	....	1.50	....
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00*
Cincinnati	1.90*	1.65*	1.90*	1.65*
Los Angeles	1.65	....	1.75*	....
Detroit	1.70	1.75	1.70	1.75
Baltimore	2.50	2.50	2.55	2.55
Montreal (del.)	2.25*	1.80*	2.25*	1.90*
Philadelphia	2.10	2.00*	2.10	2.00*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	....	....	....	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	0.85	0.90	2.50	....
Birmingham, Ala.	1.00	1.20	2.05	....
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J.	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.20	*$12.00*@$13.10	$3.75*	$2.50@3.00*
Chicago			....	
St. Louis	24.00	20.00	....	18.75‡
Boston	20.50	15.50	3.95*	*3.20**
Dallas	20.00	....	....	1.85†
Cincinnati	16.80	14.30	....	13.40‡
San Francisco	*22.00*	....	....	*1.60†*
Minneapolis	*23.00*	*20.00* (white)	*1.60†*	*1.35†*
Denver	24.00	....	....	2.70†
Detroit	22.00	20.00	....	20.00‡
Seattle, *paper sacks*	24.00	.....	2.80†	.....
Los Angeles			18.00‡	.....
Baltimore	24.25	17.85	2.55†	10.50‡
Montreal	21.00	21.00		1.45†
Atlanta	22.50	14.00	2.10†	2.20†
New Orleans	24.00	18.00	2.20†	
Philadelphia	23.60	16.00	....	15.00‡
Kansas City	*17.50*	*15.00*	*17.50‡*	1.75†
Birmingham	18.00	14.00	2.00†	

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c per bbl. Minneapolis quotes brown common lump lime; Kelly Is. and Sheboygan white are *$1.60*. New York quotes hydrated lime "on cars" in paper sacks, lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b. exclusive of bags:

	Nov. 6	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.50	2.80
St. Louis (Carney)	2.35	2.35
Birmingham (Magnolia)	pozzolan cement	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Nov. 6	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.70@2.80
New York, alongside dock to dealers	2.15	2.15	2.30
Jersey City	2.33	2.33	2.48
Boston	2.70	2.70	2.90
Chicago	2.20	2.20	2.20
Pittsburgh	2.19	2.19	2.24
Cleveland	2.39	2.39	2.46
Detroit	2.40	2.40	2.48
Indianapolis	2.41	2.41	2.41
Milwaukee	2.35	2.35	2.37
Duluth	2.19	2.19	2.25
Peoria	2.37	2.37	2.41
Cedar Rapids	2.44	2.44	2.48
Davenport	2.39	2.39	2.43
St. Louis	2.30	2.30	2.45
San Francisco	2.61	2.61	2.61
New Orleans	2.80	2.80	2.90
Minneapolis	2.42	2.42	2.50
Denver	2.84	2.84	2.84
Seattle	*2.65*	2.90	2.90
Dallas	2.05	2.05	2.05
Atlanta	2.35	2.35	2.60
Cincinnati	2.47	2.47	2.54
Los Angeles	2.60	2.98	3.16
Baltimore	2.90	2.90	2.65
Birmingham	2.40	2.40	2.80
Kansas City	*2.42*	2.70	
Montreal	1.80	1.80	2.25
Philadelphia	2.41	2.41	2.96
St. Paul	2.42	2.42	2.50
Toledo	2.45	2.45	2.48

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Hannibal, Mo.	2.05
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	2.05	Wyandotte, Mich.	2.15
Iola, Kan.	1.95	Alpena, Mich.	2.00
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	2.05	Kingsport, Tenn.	2.05

TRIANGLE MESH—Price per 100 sq.ft in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Warehouse: Chicago	New York	St. Louis	Dallas	San Francisco
032	22	$0 95	....	$1 39	$1.04	$1 13	$1 15
049	28	1 20	....	1 76	1.32	1 38	1 45
068	35	1 47	....	2 16	1.62	1 67	1 78
093	45	1 89	....	2 77	2 08	2 00	2 78
126	57	2 34	....	3 45	2.59	2 55	2 85
153	68	2 79	....	4 11	3.08	3 15	.....
180	78	3 20	....	5 70	3.54	3 47	.....
245	103	4 22	....	6 21	4.66	4 58	.....
287	119	4 88	....	7 19	5.39	5 26	5.94
336	138	5 66	....	8 35	6.25	6 11	.....
395	160	6 56	....	9 65	7.25	7.12	.....
		PAVING					
036P	17	$0 72	....	$1 06	$0 79	$0.76	.....
053P	24	1 02	....	1 50	1.12	1 07	.....
072P	31	1 29	....	1 90	1.42	1 39	.....
097P	40	1.66	....	2.45	1.83	1 90	.....
049R	24	....	....	....	1.12	1 07	.....
067R	31	....	....	....	1.42	1 39	.....
089R	40	....	....	....	1.83	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Weight in pounds	New York	Chicago	St. Louis	San Francisco	Dallas
2.2	$21 00	.....	$20 00	$24 00	$23.50
2.5	23 00	.....	21 00	26 00	25 00
3.0	27 00	.....	24 50	30 00	28 50
3.4	29 00	.....	26 50	.....	31 00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Warehouse, Uncut

Inches	Pittsburgh Mill	Birmingham	New York	Chicago	St. Louis	Dallas	San Francisco
Hand larger....	$2.00	....	$3 24	$3 00	$3 15	$3 38	$3 35
½	2.05	....	3 34	3 10	3 25	3 43	3 45
⅝	2.10	....	3 44	3 20	3 45	3 48	3 55
¾	2.25	....	3 64	3 40	3.70	3.63	3 75
⅞	2.50	....	4 24	4.00	4.35	3 78	4 35

For size and cutting extras, manufacturers and distributers, see bar card of July 1, 1923.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2 70	$3.00	$3 08	½.....	$3.10	$3 20	$3 30
⅝ in.....	2 80	3 05	3 13	¼.....	3.70	3 50	3.48
¾	2.90	3.10	3.18	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Nov. 6	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.).....	$18 00	$17.00	$22.40@23.65	$44 00†	$51.00†
New York (at dock)...	15 00	14 00	19@20	.....	.....
Chicago	.....	12 00	11.00	50 00	50 00
St. Louis, salmon.....	16@18	16@18	16@18	38@40	40@42.50
Denver, salmon.....	12 00	12 00	12 00	.....	.....
Dallas.....	12 10	12 10	11 00	35.00	.....
San Francisco	15 50	15 50	15 00	.....	.....
Los Angeles	15 00	15 00	15.50	(not used)	
Boston (del.)	*21 50*	22.00	23 00	47 50†	55 00†
Minneapolis (del.).....	14.00	14.00	16@18	.....	.....
Kansas City.....	16.50	16 50	.....	(no market)	
Seattle	15 00	15 00	15 00	.....	42.50
Cincinnati	17.00	17.00	18@19	40.00	45.00
Montreal	17.50	17.50	16 50	100.00‡	68 00
Detroit (del.).....	17.50	17.50	18.25	38.50	41.50
Baltimore.....	18.00	18.00	21.00	40.00	45.00
Atlanta	*10 50*	11 00	11.00	40.00	.....
New Orleans.....	19 50	19 50	18 75	.....	.....
Birmingham.....	12.50	12.50	12 50@14	(no market)	
Philadelphia	19 00	19.00	22.00	38.00	46.00
Pittsburgh (del.).....	16.00	16.00	16.00	.....	.....
Cleveland	16.00	16.00	16.00	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. †F.O.B. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Nov. 6 on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0 1162	$0.1179	....	$0.125	$0.077	$0.108	.....
6x12x12...	.1743	.1769	....	.....	.103	.156	.....
8x12x12...	.2179	.2211	....	.215	.14	.244	.....
10x12x12...	.....	.....	....	.....	.17	.....	*$0.2388*
12x12x12...	.....	.....	....	.....	.21	.....	*.2956*

* 5 per cent off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	$0.125	$0.23	.....
Minneapolis (f.o.b. cars).....	*.065*	*.11*	*$0.195*
Minneapolis (delivered)	.07	.12	.21
Cincinnati.....	.07485	.13745	....
Kansas City.....	.085	.145	....
Denver.....	.085	.155	.188
Seattle (delivered)	.11	.20	.30
Los Angeles	.085	.172	....
New Orleans.....	.14	.24	.....
Detroit (delivered).....	.1044	.1958	.2737
Montreal.....	.12	.225	.30
Baltimore.....	.125	.27	.....
Atlanta.....	.1004	.1674	.....
Dallas.....	.0941	.1824	.265
Birmingham.....	.11	.175	.....
Pittsburgh (delivered).....	.068	.128	.179
Cleveland	.08	.14	.....

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Warehouse: Birmingham	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in	*$1.80@* $2.00	....	$3.34	$4 15	$3.25	$3.10	$3 00
Channels, 3 to 15 in....	*1.80@* 2.00	....	3.34	4 15	3.25	3.10	8 00
Angles, 3 to 16 in., ¼ in. thick.....	*1.80@* 2.00	....	3.34	4 15	3.25	3.10	3 00
Tees, 3 in. and larger...	*1.80@* 2.00	....	3.34	4 15	3.30	3.10	3 05
Plates, ¼ in. thick and heavier.....	1 60@ 1.90	...	3.34	4 15	3.25	3.10	3 00

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York Nov. 6	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in.....	$2.60	$3.75	$4.40	$3 65	$3.65	$5.00	$4 75
CONE HEAD BOILER							
½ in.....	$2.90	$3.85	$4 50	$3 75	$3.85	$5 20	$5.00
⅝ and ¾.....	3 05	4.01	4.66	3 85	4.10@4.35	5 35	5.15
⅞ and 1⅛.....	3.30	4.25	4 90	4 10	4.50	5 60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	*$2.75*	$3.75	....	$4.20	*$4 85*	$3.24	$4.95
Cut.....	2.90	4.25	....	5.25	5 00	3.49	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco—Galv.	San Francisco—Black	Seattle Black
½.....	*$8.00*	*$6.00*	$7.75
⅝.....	*7.30*	*5.30*	5.40
¾.....	*7.15*	*5.15*	5.50

Pittsburgh base in lots of 200 kegs or more, *$3.00*

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.64 per roll to consumers in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $6.95 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $6.05 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to consumers in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$85.73
Tar pitch (in 400-lb. bbl.), per 100 lb.....	2 13
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	40.50
Asphalt felt (light), per ton, f.o.b. plant*.....	87.75
Asphalt felt (heavy), per ton, f.o.b. plant*.....	87.75

* Delivered in Metropolitan Dist., $2.00 additional.

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 86 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent; "A," 85 per cent; "B," 88 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$2.60@2.70	$3.90	$3.80	$3.95	$3.89
No. 12.....	2.70@2.80	3.95	4.05	4.00	3.94
No. 14.....	2.80@2.90	4 00	4.10	4.05	3.99
No. 16.....	3.00@3.10	4.10	4.20	4.15	4.09
Black					
*Nos. 18 and 20.....	3.25@3.35	4.45	4.55	4.80	4.40
*Nos. 22 and 24.....	3.30@3.40	4.50	4.55	4.85	4.45
*No. 26.....	3.35@3.45	4.55	4.60	4.90	4.50
*No. 28.....	3.40@3.50	4.65	4.50	5.00	4.60
Galvanized					
No. 10.....	3.50@3.60	4.65	4 60	4.90	4.60
No. 12.....	3.60@3.70	4.75	4 70	5.00	4.70
No. 14.....	3.60@3.70	4 75	4 70	5.00	4.70
Nos. 17 to 21.....	3.90@4.00	5 05	5.00	5.30	5.00
Nos. 22 and 24.....	4.05@4.15	5 20	5 15	5.45	5.15
*Nos. 25 and 26.....	4.20@4.30	5.35	5 30	5.60	5.30
*No. 28.....	4.50@4.60	5.65	5 50	5.90	5.60

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Nov. 6	New York: One Year Ago	Chicago: Nov. 6	Chicago: One Year Ago
Raw in barrels (5 bbl. lots).....	$1.08	$0.98	$1.05	$1.14

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	Nov. 6	1 Yr. Ago	Nov. 6	1 Yr. Ago
Red	15 25	14 00	16 75	15 50
White	15 25	14 00	15 25	14 00

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$28.00	$29.00	$30.00	*$33.00*
3x6 and 8	28.00	29.00	30.00	*33.00*
4x4-6 and 8	28.00	29.00	30.00	*33.00*
3x10 and 12	28.00	29.00	30.00	*33.00*
3x14	34.00	*32.00*	*34.00*	*36.00*
4x10 and 12	28.00	29.00	30.00	*33.00*
4x14	34.00	*32.00*	*34.00*	*36.00*

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$30.00	$32.00	$34.00
6x14	*35.00*	*37.00*	*39.00*
8x10	30.00	32.00	34.00
8x14	36.00	*37.00*	*39.00*

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	$40.00	$41.00	.....	.....
3x10 to 10x10	45.00	46.00	.....	.....
3x12 to 12x12	*50.00*	*51.00*	.....	.....
3x14 to 14x14	*57.00*	*58.00*	.....	.....
3x16 to 16x16	*65.00*	*66.00*	.....	.....
3x18 to 18x18	.....	.....	.....	.....
4x20 to 20x20	.....	.....	.....	.....

*Wholesale price to dealers; to contractors, delivered from lighters or cars to ob, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$56.00	**$54.00†**	**$50.00**	**$50.00**	*$67.00*	*$65.00†*
Seattle	.....	29.50	.....	.....	.....	26.00
New Orleans	29.00	.....	.....	.....	39.00	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Montreal	50.00	58.00	.....	.....	60.00	65.00
Los Angeles	.....	37.00	.....	.....	.....	38.00
Denver	.....	35.75	35.75	35.75	.....	**36.75**
Minneapolis	40.00	**38.75**	39.00	.....	43.00	**38.75**
Atlanta	*31.00*	.....	.....	.....	*34.00*	.....
Dallas	52.25	.....	.....	.....	57.20	.....
Kansas City	**39.50**	.....	.....	.....	*47.50*	.....
Birmingham	.....	.....	.....	.....	.....	.....
Philadelphia	**42.00**	**36.00**	**42.00**	43.00	**52.00**	36.00
Detroit	**46.25**	**49.75**	.....	.....	**56.75**	**58.75**
St. Louis	**44.00**	.....	.....	.....	**56.00**	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	**$46.00**	**$45.00†**	**$45.00**	**$53.00**	**$52.00†**
Seattle	.....	25.00	.....	.....	29.00
New Orleans	67.00	.....	.....	33.00	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	75.00	80.00	75.00	38.00	88.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	32.00	.....	.....	**81.00**
Denver	.....	**33.25**	**33.25**	.....	*30.75*
Minneapolis	43.00	35.75	35.50	37.00	32.75
Atlanta	*19.00*	.....	.....	*29.00*	.....
Dallas	52.25	.....	.....	55.75	.....
Kansas City	*63.00*	.....	.....	*61.25*	.....
Birmingham	.....	.....	.....	.....	.....
Philadelphia	**30.00**	35.00	41.00	**42.00**	**36.00**
Detroit	38.75	**37.00**	.....	*42.50*	**38.50**
St. Louis	**43.00**	.....	.....	**32.00**	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.
*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Nov. 6	One Month Ago	One Year Ago
$1.95@2.05	$2.10@2.15	$2.65

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; ⅞-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

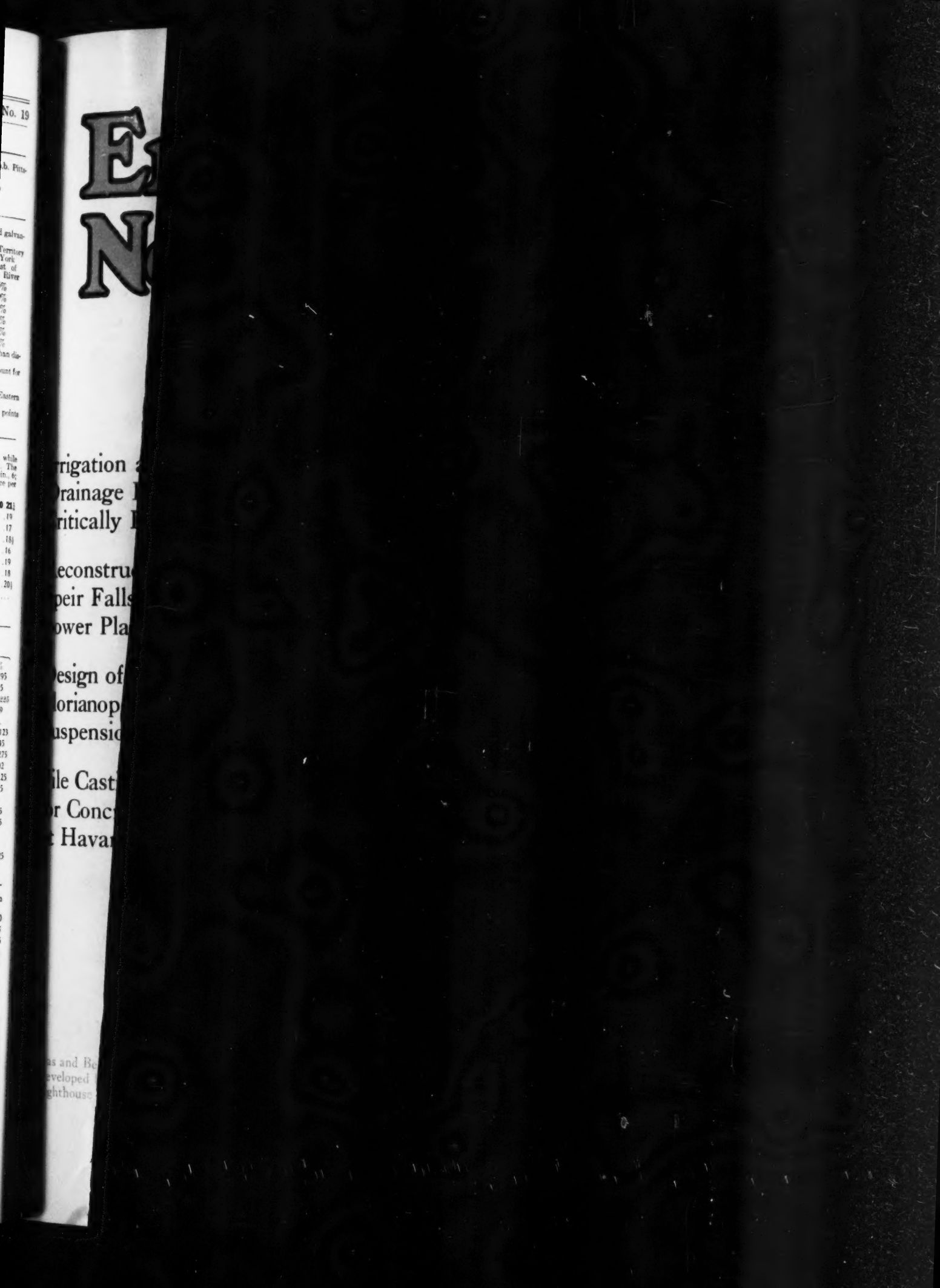
Boston	**$0.17 @.22**	New Orleans	**$0.21½**
New York	.18½	Los Angeles	.19
Chicago	...	Seattle	.17
Minneapolis	**.23½**	St. Louis	.18½
San Francisco	**.21**	Montreal	.18
Atlanta	*.19½*	Detroit	.19
Denver	**.25**	Baltimore	.18
Cincinnati	.21	Kansas City	.20½
Dallas	.21	Birmingham	...
Philadelphia	**.18½**		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.23	.25
Kansas City	.2025	.2225
Seattle	.165	.19
Chicago	...	...
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2125
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	...	...
New Orleans	.235	.29
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.35@1.40
Sulphate of copper, in bbl., per 100 lb.	4.40@4.65
Soda ash, 58%, in bags, per 100 lb.	1.25@1.45
Chlorine, liquid, cylinders, 100 lb., per lb. (f.o.b. works)	.05½@.07½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.20@2.25

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.15
Cincinnati	.29	Philadelphia	.32
Cleveland	.19	St. Louis	.43
Denver	1.15	St. Paul	.60